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ELEMENTARY BANDAGING

AND

SURGICAL DRESSING.

WITH DIRECTIONS CONCERNING
THE IMMEDIATE TREATMENT OF CASES
OF EMERGENCY.

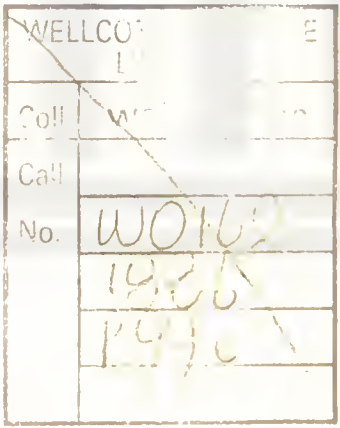
FOR THE
USE OF DRESSERS AND NURSES.

BY
WALTER PYE, F.R.C.S.,
Surgeon to St. Mary's Hospital; Late Examiner in Surgery in the Glasgow University, etc.

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NOTICE TO READERS.

This little book is chiefly a re-issue of those portions of "Surgical Handicraft"* which deal with bandaging, splinting, etc., and of those which treat of the management in the first instance of cases of emergency, only such new matter being added as is required to give some sort of continuity to the extracts.

While I am anxious that the book should not pretend to be anything but a reprint, I yet hope that within its own limits it is fairly complete, and that it will prove to be useful to students when they begin their work in the wards and casualty rooms, and useful also to surgical nurses and probationers.

Walter Pye.

4, Sackville Street,
March, 1886.

* 2nd Edition, 1885. Kimpton.

J. WRIGHT & CO., BRISTOL.

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ELEMENTARY BANDAGING.

SECTION I.

OF APPARATUS FOR RESTRAINT AND SUPPORT (BANDAGES, SPLINTS, ETC.).

CHAPTER I.

OF BANDAGES AND KNOTS.

THE first part of this section deals with the several kinds of bandages, and the second part with splints in their varieties and modes of application.

Bandages may be roughly divided into "triangulars," or "scarfs," "rollers," and bandages of special form, such as the "T," the "H," or the "many tailed." The material of which they are made is usually grey shirting, *i.e.*, unbleached calico, but roller bandages are often made of flannel, or of some woven material, for greater elasticity or strength; or of muslin for holding plaster of Paris, etc. Old household linen makes very good bandage material, and short of being rotten, the older the stuff, the more comfortable will it be.

The choice of the form of bandage, and of the material, will depend on consideration of such points as these—

The amount of restraint or support required. Thus, a simple triangular bandage will serve best to keep a water dressing on the scalp, while a twisted or knotted roller will be required to restrain the hæmorrhage from a recent wound there.

The effect of the bandage on the skin and circulation of the part. Consideration of this point leads to the selection of material, care as to its tightness, and

choice of the best method of applying it. Thus, in a limb likely to swell, an elastic pattern, such as a "figure of 8" will be chosen, while if firmness be most required, the "turned" bandage should be used.

The length of time the bandage will have to be kept on. If the bandage be for a temporary purpose only, there will not be the same elaboration required as if it were meant to be kept on for some time; in this latter case the particular plan will often be settled from considerations of future cleanliness.

THE TRIANGULAR BANDAGE.

This bandage is the half of a square 36 inches, and is usually made of unbleached calico; it has for some years been used in military surgery, but in the surgical work of civil hospitals it is still much neglected. It is peculiarly applicable to out-patient surgery, or to the dressing of accidental injuries, and can be used for dressings of very different kinds, indeed, in almost all forms, except when a smooth, even, and regular pressure is required.

The first and most obvious use of this bandage is to simply tie it round where it may be wanted, with a reef knot, it having been previously folded up into a cravat. In a case of venæsection the arrest of the venous circulation above the incision may be effected thus, or improvised splints may be attached, or a leg swung from a cradle, etc.

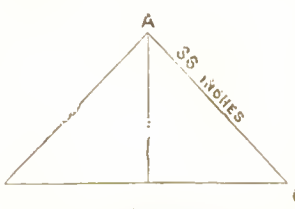


FIG. 1.—*The Triangular Bandage.*

The *sling* is another very useful bandage, and very quickly put on: indeed, of all the applications of the triangle it is the most frequently required. Although its application may be shown in a few seconds, a written description of it as with other bandages and knots is more complicated.

Let the right angled corner be called A, and the upper and lower acute angled ones B and C respectively.* Standing in front of the patient, corner A should be placed in the axillary line on the affected side, midway between the axilla and the ilium, B should reach up to, and hang over the opposite shoulder. The line B to C will then hang diagonally across the body, and between it and the arm to be slung. The arm should be placed in the required position, and C brought up over the shoulder on the affected side and tied with B in a bow behind the neck. The elbow should then be kept in position by pinning A round it as shewn in the figure. (Fig. 2.)

In slinging the forearm the sling should be made just short enough to slightly elevate the shoulder, or the patient will not trust all the weight of the limb to it. The hand should be a little higher than the elbow. Sometimes, as in fractures of the humerus, the weight of the forearm is used as an extension, while the hand and wrist alone are slung by the bandage folded up into a cravat, three or four inches wide, and tied behind the neck.

The head bandage (Fig. 2) differs hardly at all from the picturesque head-dress of the Italians, which may be seen



FIG. 2.—*The Sling and Head Bandages.*

* These letters apply to the rest of the triangular bandages where they appear on the figures, in the same way.

worn in the metropolis by the women organ-grinders of Saffron Hill. It is very useful as a cap to retain dressings in their place on the scalp, but it is not fitted for compression. As a cap it is infinitely superior to the "capeline" roller bandage, which is hot and difficult to apply.

Standing behind the patient, who should be sitting down, the middle of the long side of the bandage, opposite A, is placed along the forehead above the eyes, the triangle covering the head, and corner A hanging down behind; the rest of the long side is then brought round the sides of the head, taking care that the hands, as they apply the bandage, are kept low, so as to bring the lower edge well below the occiput. The tails B and C should be crossed, *not knotted*, over A, below the occipital protuberance, and brought forward again round the head to the forehead, where they must be tied. A is then turned up and pinned to the surface of the triangle on the head.

The only points to be attended to, are the keeping the hands low while working from before backwards, and to cross the ends well below the occiput. If this is done the cap cannot slip off, and if not, no tightness will make it firm.

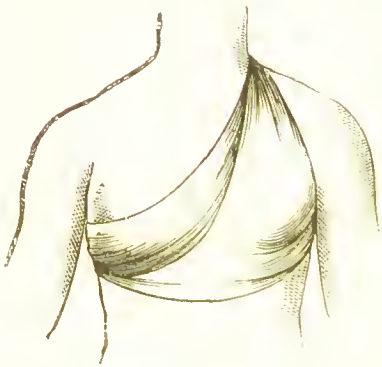


Fig. 3.—*The Chest Bandage.*

The chest or back bandage (Figs. 3 and 4) is again very useful for retaining such applications as poultices, to the trunk, and its employment saves much laborious and wasteful use of broad roller bandages which do not answer the purpose nearly as well.

The method is the same whether the bandage be

applied in front or behind, so that one description will suffice for both back and front, if the terms are reversed.

Standing in front of the patient the right-angled corner A is placed over one shoulder, and the long



FIG. 4.—*The Back Bandage.*[*]

side adjusted round the waist. Then the ends B and C are tied behind, on the same side as the shoulder over which A is hanging. Thus one of the ends will be left long at the waist behind, and this should be taken up and fastened to A, with a knot or a safety-pin, the junction being about the posterior border of

[*] The knots in this figure are placed too near the middle line of the back; they should be at the upper and lower angles of the scapula, on the left side, as stated in the letterpress.

the seapula, and therefore out of the way of pressure when the patient lies down.

The shoulder is most seeurely bandaged with two triangles as in Fig. 5. One folded into a searf, is fastened diagonally across the body, over the injured shoulder, and under the opposite arm pit. The corner A of the other is then pinned to it so that the centre of this bandage eovers the point of the shoulder, and B and C are crossed over and tied ronnd the arm below the axilla.

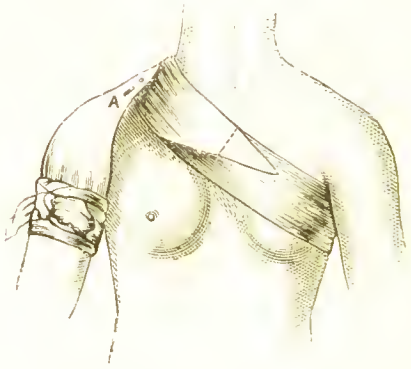


Fig. 5.—*The Shoulder Bandage, with Two Triangles.*

The shoulder may also have a dressing retained upon it by using one triangle only, on the same plan as for the knee (Fig. 6), namely, by plaeing the bandage, so that the point of the shoulder is eovered by its centre, with A pointing towards the ear, and the long side lying horizontally across the arm. B and C are brought round and crossed behind the arm below the armpit, and then bronght up and tied above the shoulder over A, which may be turned down and pinned. In these bandages there is no pressure upon. or restraint of the joint itself; this can only be attained by the roller.

The same remark applies to the application of the triangular bandage to the *elbow, knee, hand and foot.* The methods of application in all these cases are similar. In the elbow and knee A is put upwards, the joint is covered by the middle of the bandage, and the long side lies horizontally across the forearm or the leg. B and C are then crossed behind the limb, brought round and tied in front, and A is then turned down over the knot and pinned. For the hand or foot the limb is placed with the digits pointing to A, and with the end of the big toe or the middle finger at the centre of the bandage. A is turned over the hand or the foot; B and C are then brought up and crossed over the back of the wrist or the ankle, and tied in a bow or reef knot behind. In the same way *a stump* (Fig. 8) may be easily and well tied up, provided that pressure be not required.

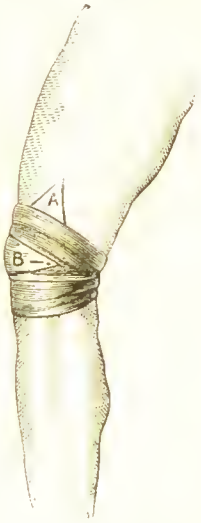


FIG. 6—*Bandage for the Knee, etc.*

Bandages of the gluteal region. The most useful are the *gluteal*, the *perineal* and the *scrotal.* In all of these, two triangles will be required, the one for the part itself being attached to the other, which is fastened as a belt round the waist. In the *gluteal* bandage (Fig. 9), the belt being tied round, A is fastened to it behind above the posterior iliac spine, so that the middle of the base of the triangle falls just below the *gluteal* fold. B and C are then brought round the top of the thigh and knotted or pinned



FIG. 7.—*The Hand, Bandaged.*

together. Both buttocks of course may be bandaged if three triangles are used.

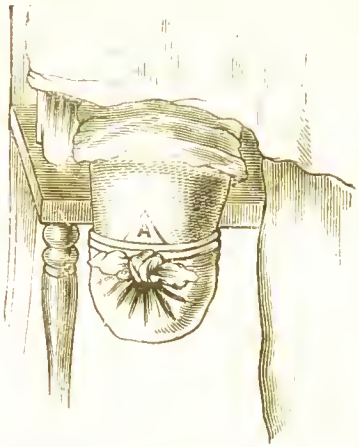


FIG. 8.—*A Stump, Bandaged.*

The bandage for the *perinæum* is usually applied by folding both bandages into cravats, and fastening one as a belt, and the other in the middle line behind and in front, passing it between the legs and spreading it out a little in the perinæum.

A more effieient bandage, which serves at the same time to cover the buttocks can be made by reducing the bandage from a right angled to an acute angled triangle, by taking in a plait of about six inches in the base, or long side of the triangle, then fastening A in front of the pubes, and the middle of the base (for the width of the plait) behind, to the belt with safety pins.

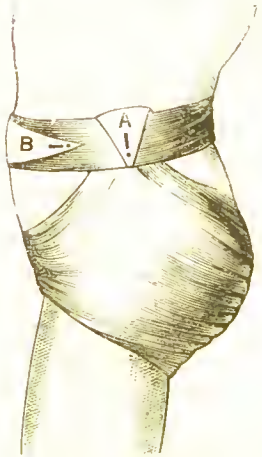


FIG. 9.—*Gluteal Bandage.*

There will then be three folds of the bandage smoothly covering the perinæum, while B and C being brought round to the sides, will cover the buttocks, and may be fastened to the belt, towards the middle line in front.

The *scrotal* bandage gener-

ally requires a smaller second triangle than the others, or a large one folded once will do. It is adjusted thus :—The belt being put on as before, A is fastened to it in the middle line in front, so that the middle of the base comes to the central point of the perinæum. The scrotum and penis are then slung up and covered by bringing up B and C, turning them round the belt on either side of the middle line, from behind forwards, and passing underneath first. They are then tied together in a bow or knot over the root of the penis, as is usually figured, or secured with pins to the belt, as in Fig. 10.

Lastly, a tolerably efficient bandage *for one or both groins* may be fashioned by folding a triangle as a scarf and then applying it as a simple figure of 8 (often wrongly called a spica), placing the middle of the scarf at the apex of the fork of the legs, carrying the extremities along the fold of the groin in front, and of the buttocks behind, crossing them at the great trochanter, and then carrying them round the pelvis to the opposite side, keeping below its brim, and tying the ends together (Fig. 11.)

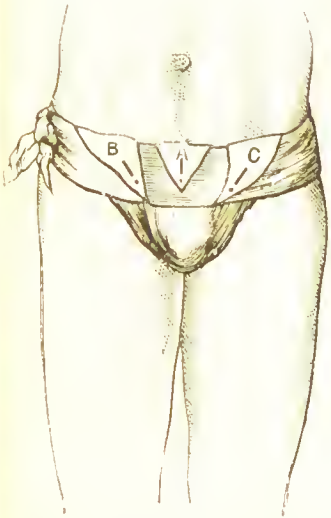


Fig. 10.—*Scrotal Bandage.*

THE ROLLER BANDAGE.

In the case of the *roller bandage*, to apply it neatly is to apply it well, but the art of using this bandage properly is one not to be learned without practice, even though it be freely allowed that the

subject has been quite uselessly complicated by needless rules and patterns.

As to the materials for these roller bandages, it has been said before that a strip of any stuff which fulfils the conditions of sufficient strength, with lightness and softness will do. The length of the strip varies from 4½ to 6 yards, the width from 2 to 4 inches; 2½ and 3½ inches being the commonest sizes.



FIG. 11.—*Bandage for Groin.*

For the purposes of description roller bandages may be divided into *elastic*, *semi-elastic*, and *in-elastic* kinds.

Elastic bandages are of several kinds, woven, india-rubber, etc.

The semi-elastic bandages are either woven in a special manner or made of a somewhat elastic material. Under this heading come all flannel bandages, domette, cotton or silk net, etc.

The application of these bandages is much more simple than that of the in-elastic, for they will lie smoothly, if they are merely rolled on firmly, so that they hardly ever require turning or other manipulation. They should be rolled up rather loosely before use.

The in-elastic, or common bandages, are the most frequently used, especially in hospital, where the other kinds would be too expensive, even if they were firm enough for the requirements.

They are usually made of "grey shirting" or unbleached calico, or the same bleached; or for

bandages about the eyes or face, a very cool light bandage may be made of finer cotton stuff, or linen. Very old worn linen is not infrequently used, and speaking generally, it may be said that washed stuffs are better than new. They should always be torn, and no self-edges retained.

The general rule is to use the $2\frac{1}{2}$ inch bandage for the arms and head, the $3\frac{1}{2}$ inch for the legs and pelvis, and the $4\frac{1}{2}$ inch width for the chest and abdomen.

Except for the trunk, however, it will be found that the narrowest bandage is the easiest, and the most comfortable to apply in all cases.

In order to apply the *common roller bandage* to any part of the body, the first thing to learn is how to judge of the firmness and support required, and to distribute the pressure evenly about the limb. For this purpose the bandage must always be kept rolled up (dropping it is a sure sign of a bungler or beginner), and held (as in Fig. 13), three or four inches away from the part, while the finger and thumb are used to

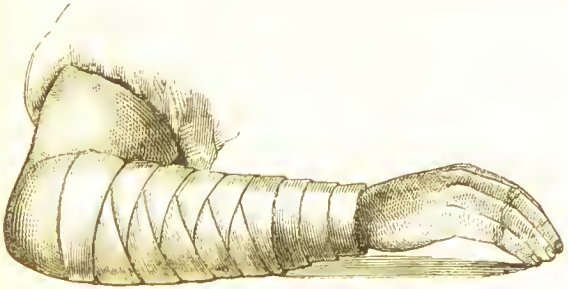


FIG. 12.—*Forearm bandaged below with a simple Spiral; above with the "Reversed" Spiral Roller. The latter grasps the limb evenly, the former does not.*

retain the bandage in its place when it is being applied. The next point is the manipulation known as "turning" or "reversing," by means of which the bandage is turned over on itself while it is being applied. The object of

this turning is that the bandage may be smoothly, and be firm as well, for inasmuch as all parts of the limbs, etc., are constantly varying in diameter, and the edges of the bandage will not stretch to make one side longer than the other, it follows that if it be simply rolled on in a spiral fashion, only the largest diameter of the limb covered by each turn of the bandage will be grasped by it, and the bandage will be loose elsewhere, as in Fig. 12.

To avoid this, the bandage is, when necessary, turned over as in Fig. 13, and by this means the upper and lower edges are frequently changed, so that the whole width of the bandage grips the limb. This turning requires a little knack, but is easily learned. The secret of doing it well consists in having the

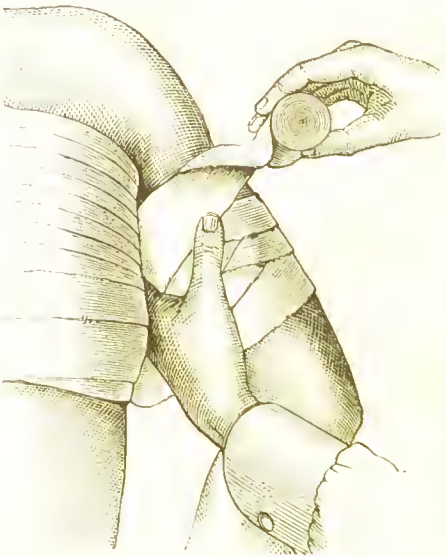


FIG. 13.—*Application of the Reversed Spiral*

portion in the hand (Fig. 13) quite loose, so that by bringing the roller down, it naturally falls over. The thumb must, therefore, be holding the turn of the bandage last applied during this manœuvre. Moreover, the bandage should be brought across the limb with a good slope upwards, say 45° to the long axis, and the reverse similarly be brought boldly down, so that the bandage is well doubled over, otherwise some of the fold will appear on the other side of the limb when the bandage comes round.

The most common fault is that of screwing the roller round on its own axis, instead of allowing the bandage to fall over into position, as it should do almost of its own accord.

As a rule it is best to turn every time the bandage comes round, and the turns should be made in the same straight line; but these points are not essential, and indeed both depend rather on the æsthetics of bandaging, than on any practical advantage.

Another rule, which may often be more honoured in the breach than in the observance, is that the bandage must be rolled on from within outwards. Thus in fractures of the thigh, if the leg be adjusted to the splint, and the bandage put on in accordance with this rule, every turn that is made will tend slightly to

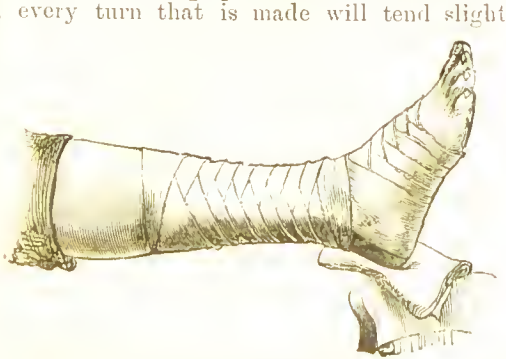


FIG. 14.—*Reversed Spiral of Foot and Leg.*

increase that external rotation which is the great obstacle to proper position, while the reverse will be the case if the bandage be applied from without inwards.

The roller bandage with reverses is the commonest of all the ways of bandaging. It may be applied to the trunk or limbs (as in Fig. 14), to fasten splints, and on an infinite number of other occasions.

Nevertheless it is somewhat liable to slip, is not elastic, and is not suited for the neighbourhood of joints.

In its stead, a pattern of roller bandage which is hardly ever used in England, might well be employed more frequently, namely, the *double headed spiral with reverses*. (Fig. 15.) Its description, like that of many other bandages, is more complex than its application. The bandage is a combination of a simple spiral roller, with a reversed spiral, so that whilst one head of the roller is applied spirally, each of the turns thus made

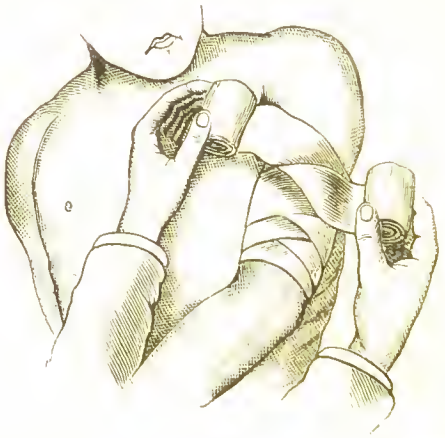


FIG. 15.—*Double-headed Spiral with Reverses.*

is covered and fixed by a reversed turn made with the

other head. Inasmuch as even compression can always (other things being equal) be more efficiently made with a double headed, than with a single roller, the value of this pattern lies in the firmness with which it can be applied to a limb, while it is nearly impossible that it should slip. The heads must of course be of unequal length; that used for the reverses being the longer. The pattern requires some practice to apply with ease, but the labour will be well spent.

A pattern which is at once firm and elastic, and which can be applied over most articulations, is the *figure of* 8 (Fig. 16.) This bandage, when applied to the length of the limb, or over a joint so as to cover it completely, presents much the same appearance when finished as the spiral roller with reverses (compare Figs. 13 and 16), but in its application it is entirely different. The accompanying illustration (Fig. 16) will give a better idea of its application than any words can do. The great point to bear in mind is to make the loops of the 8 as open as possible, by going

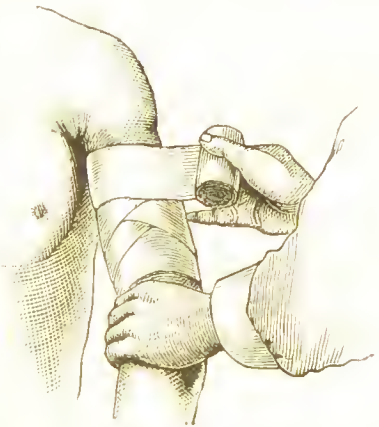


FIG. 16.—*Application of the Figure of* 8 *Bandage to a Limb.*

boldly up the limb and coming down again as far as the bandage will allow.

As has been implied, this bandage may be employed in almost all the cases in which the turned bandage is generally used, and it is often really preferable, being not less firm and yet more elastic, but as a rule its employment is confined to the neighbourhood of joints, so that if a limb *and* a joint, or joints, have to be bandaged, say the ankle, leg, knee, and thigh, there would be a turn or two placed round the foot, then the ankle would have the figure of 8 (leaving out the heel), the leg, the turned (see Fig. 14), the knee, the 8, and the thigh the turned again.

One practical reason for this change is that the figure of 8 requires twice as much bandage to cover a limb as the turned spiral does.

The 8 bandage is also used for joints, simply as one or two turns, crossing over the centre of the flexor aspect of the joint. (Fig. 17.) This pattern is useful in a number of cases, which may be imagined.

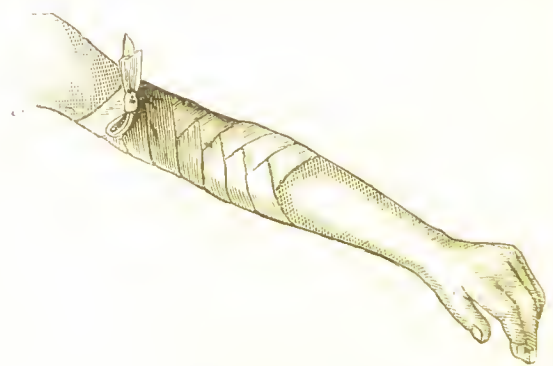


FIG. 17.—*Figure of 8 for Bend of Elbow.*

The point of the heel, and the *point of the elbow*, with their respective joints, may be completely covered by a series of enlarging figures of 8, starting from the

centre, having the crossing placed over the front of the joint, and the loops above and below the line drawn from the middle of the front of the joint to the heel or the oleeranon, and getting always more and more open, and further away from the middle line as the bandage progresses. (Fig. 18.) In this way the elbow may be conveniently bandaged. The heel pattern is nearly or quite the hardest one to adjust of all the common forms. It is very neat looking, but it is seldom worth the trouble of its application save as an exercise in bandaging.

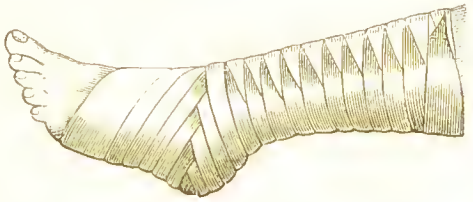


FIG. 18.—*Bandage taking in the Heel.*

The spica (*spike or spathe*, a botanical term applied to heads of seeds arranged as in a ear of wheat) is extremely useful for applying firm pressure to joints, or fastening dressings over them. The pattern is the same, whether the bandage be applied to the shoulder, groin, thumb or great toe, and is that of a figure of 8, combined with a firm attachment to a limb in the neighbourhood of the joint,—the wrist for the thumb, the arm for the shoulder, the thigh for the groin, and the ankle for the great toe. Taking the *spica of the groin* as an example (Fig. 19), the bandage begins by two or three reversed turns from within outwards (or overlapping 8's) round the top of the thigh. The bandage is then carried outwards over the groin to just below the anterior spine of the ilium, and then round the back, taking care to keep just below the iliac crest. The bandage is then brought obliquely across over the symphysis pubis, crossing over the starting point to

reach the outer part of the top of the thigh, and is then passed round it, and brought up ready to repeat the roll, but this time a little lower down, and so on till the groin and hip are sufficiently covered. The hip should be very slightly flexed at the time, and care must be taken not to slip on to the abdomen with the bandage, as it is passed round the brim of the false pelvis.

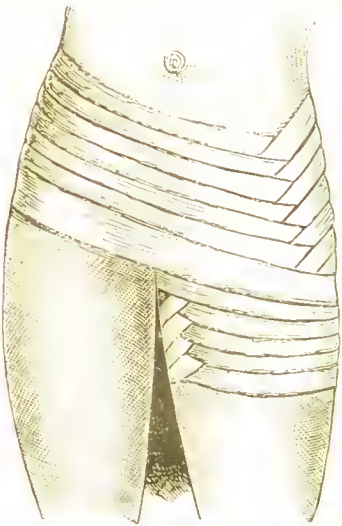


Fig. 19.—*Spica of Groin.*

With a long bandage the spica may be easily enough applied to both groins, starting from one side, and repeating every manœuvre on the other before returning; but in practice this is a bandage very rarely used, and requires mention only. The principle of the spica being understood a detailed description of the different applications of the pattern is not called for, and the especial points only will be noticed. *The spica of the shoulder* is an extremely firm bandage (Fig. 20), the starting point is taken from the upper arm, the turns being rolled round as high as the axillary folds will allow. Then the large loop of the S is taken round the chest, passing under the opposite armpit, and the crossing of the first turn should go as high up upon the shoulder as the bandage will lie. The succeeding turns will come successively lower and lower down, until the shoulder is covered in. This pattern requires a long bandage, and it may, as in the case of the groin spica, be doubled for both shoulders if required.

The spica of the thumb (Fig. 21) is the regular bandage for the common sprain of that joint. As with the bandages for the phalanges, the roller must be quite narrow, not more than three-quarters of an inch wide. The spica is begun with a few turns round the wrist, from within outwards, if the outside of the thumb is to be the most supported, and the reverse if the ball be the part requiring the firmer pressure. It is then taken round the thumb as high as the bandage will lie, and the succeeding turns, lower and lower, (as in all spicas) till the ball is covered. It is then fastened round the wrist either by a safety pin, or by splitting the end of the bandage into two tails, which are tied together. *The spica of the big toe* (Fig. 21) is applied in precisely the same way, the ankle standing in the place of the wrist. It is however more difficult to apply without getting an awkward quantity of bandage material between the toes.

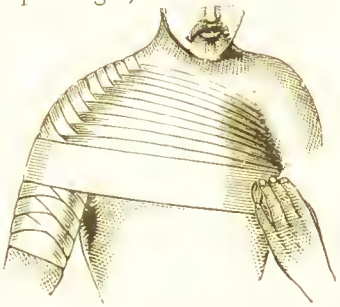


FIG. 20.—*Spica of Shoulder.**

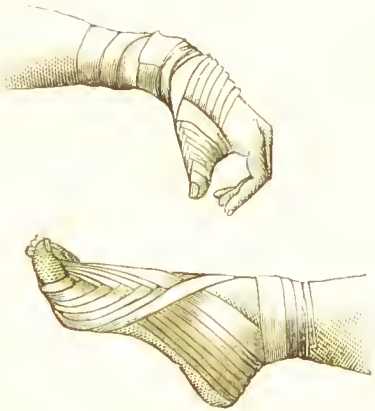


FIG. 21.—*Spicas of the Thumb and Big Toe.*

* The bandage in this figure is needlessly long.

The fingers may sometimes be sufficiently covered with a simple spiral bandage, or with reverses, or 8's, using a narrow bandage with neat edges, commencing at the tip, and finishing off at the root of the finger.

But, as a rule, to bandage the fingers or the whole of the thumb efficiently, a combination of spirals and 8's with the spica is required. Taking the fore-finger as an example (Fig. 22), the bandage is fixed by a few turns round the wrist, and is then brought up across the back of the hand from the radial side of the wrist (or along the palm from the ulnar side if preferred), and is passed between the fore and middle fingers, and half round the former as if to make a spica. Instead of completing the 8, however, the bandage is carried

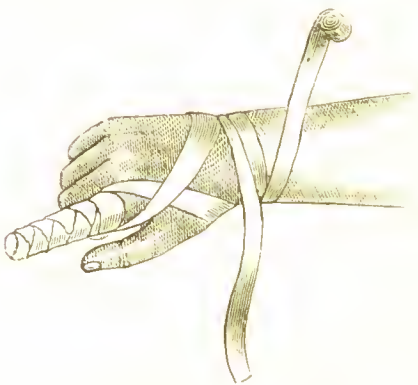


FIG. 22.—*Finger Bandage.*

in a bold spiral up to the tip of the finger, which is then bandaged carefully downwards to the root. This may be done with simple close spirals, or with small 8's, or reversed spirals if the bandage be wanted to look very neat. The bandage is then finally brought out between the fore and middle fingers, and descending, is crossed at the knuckle over the ascending por-

tion, to go to the ulnar side of the wrist, round which it is fastened in the ordinary way.

If the description has been followed, there will be no difficulty in understanding how *all the fingers* may be bandaged successively in the same way (Fig. 23) with one bandage, by starting round the wrist as before, and going over first to the little finger, then round the

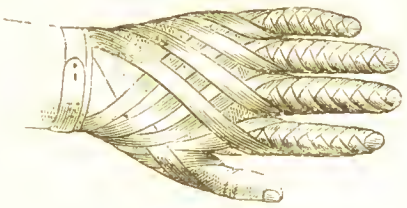


FIG. 23. —*Bandage for all the Fingers.*

wrist, then to the ring finger, and so on. In this way the palm is left free, and the back of the hand covered. but if it be desired to cover the palm and leave the back of the hand, this is readily done by starting from the ulnar side of the wrist and going across the palm to the thumb or forefinger, as in the case of the single finger. As a rule it is convenient to make a separate bandage of the thumb, but it may be included if desired. In any case a long bandage, not more than $\frac{3}{4}$ inch wide must be chosen, and unless the bandage be soft, and have clean-cut unfrayed edges, it can hardly be made to look very neat.

The principal use of this pattern is as a precaution against œdema of the fingers ; it is not so often put on now as it used to be.

All applications of a roller bandage to a conical part, must inevitably be somewhat insecure unless put on very tight, and this is generally unwise. It is therefore difficult with any form of roller bandage to apply exactly the amount of pressure which is deemed desirable to an amputated stump, and yet have the bandage

secure against slipping off. The *bandage for a stump* (Fig. 24) is a pattern known as the *recurrent* bandage. The roller for this should never be more than two inches wide, and for an amputation of the arm, or for a "Syme" it may well be still narrower. The bandage is first attached three or four inches above the stump by one or two circular turns, and then, the thumb being placed over the middle of these turns in front, and the fore finger similarly behind, it is brought right over the face of the stump from the middle line in front to the same point behind. This reverse is kept in its place behind by the fore-finger, and the bandage is brought back again, now a little to one side of the middle, but converging to that point when it reaches its starting point. This is then fixed by the thumb, and the bandage is brought over again, passing this time to the other side of the middle line, and converging to it behind. These reverses are continued till the whole stump is covered, and then by one or two firm circular turns they are fixed in the position in which they were held by the thumb and finger, as shown in the figure. It is often wise to make a circular turn or two in the course of making the reverses so as to fix those already made. This pattern may also be put on, so as to cover half or all the head, and may be made tolerably secure if care be taken that the circular turns are kept low down on the forehead and well below the occipital protuberance.

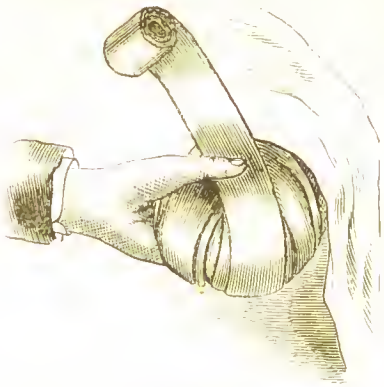


FIG. 24.—*Recurrent Bandage for Stump.*

Amputation stumps and also *the head* may be bandaged by a method which although it results in a pattern which looks like the recurrent, is yet different in principle, and firmer—namely by the use of a "double headed" roller, a bandage, that is, both ends

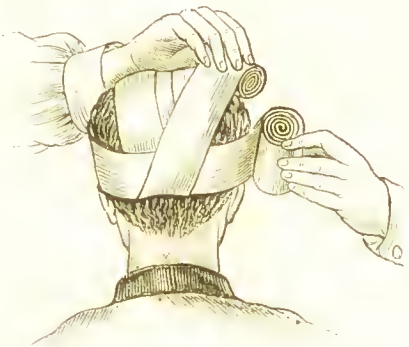


FIG. 25.—*Capeline Bandage.*

of which are rolled up towards each other in the centre. This is the bandage which when applied to the head is known as the "capeline." The application for a stump is the same in all respects. To put on the capeline it is more convenient for the patient to be sitting. The surgeon standing in front or behind takes one head of the roller (Fig. 25) and places the middle of the bandage on the occiput or the forehead. The two parts are then brought round and crossed on the forehead or below the occiput. One of the ends is then continued round, and the other, which is lying below it, is turned up and brought over the head as in the "recurrent" bandage. It is now met by the other half of the bandage which has gone round the head, while this half has gone over it, and the former continued round, fixes the bandage so that it can again be brought over the head, when the manœuvre is repeated. In this

way by adjusting the subsequent turns of the bandage alternately to one side and the other of the first one, either half (Fig. 26) or the whole of the head may be covered with folds converging to the middle line in front, and behind, and a somewhat attractive bandage is made. Its appearance is however almost



Fig. 26.—*Capeline for Half the Head.*

its only good quality. It is firmer than the simple recurrent bandage, but is still very liable to slip. It is troublesome to apply, hot, and if at all tight round the head apt to become painful, while it fulfils few indications which cannot be at least as well met by the more homely, but far more comfortable triangular bandage. (Fig. 2.) When applied to a stump, however, it may sometimes be useful.

Another application of the double headed roller which is not often used in this country may here be mentioned, namely the *double spiral* (Fig. 27). The two spirals crossing each other in front and behind, make an open bandage which is convenient enough for retaining dressings.

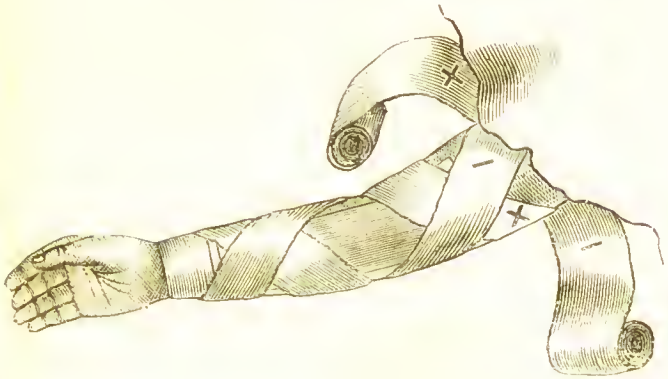


FIG. 27.—*Double Spiral Bandage.*

The *twisted or knotted* bandage for the head (Fig. 28) is generally described as one which requires a double headed roller, but this is not at all necessary or desirable. It is an extremely useful bandage, and is easy to apply. For example, taking the neighbourhood of the temple as the situation in which the pressure of the twist is required, the bandage should be unrolled for about a foot, and the end held in the left hand, which is kept close to the temple. The roller is then carried round the forehead and occiput, so that it comes back to the unrolled end at the wound. The roller is then twisted round sharply as shewn in the figure, and is carried down below the chin and round



FIG. 28.—*Twisted Bandage for Head.*

to the vertex. On coming to the temple again the same twist is made, and the roller is once more passed round horizontally; when sufficient pressure is obtained the bandage is fixed by knotting the two ends together.

The *four-tailed bandage* is a very useful pattern and serves for the attachment of dressings in wounds about the chin or face, as well as for fractures. For the bandage (Fig. 29) a piece of shirting four or five inches wide and two feet long is required. It is then doubled on itself and torn down, until a piece four inches long only is left undivided in the middle. In the middle of this a slit two inches long is generally cut, in which the point of the chin is inserted, but this is often omitted.



Fig. 29.—*Four-tailed Bandage for Jaw, with Chest Bandage.*

The middle of the undivided part is placed over the chin, and the under pair of the four tails made by tearing the bandage, are then brought up over the side of the face in a line with the masseter muscle, and loosely knotted or held half an inch in front of the vertex of the skull. These pass underneath the other pair, which are brought round to just beneath the occipital protuberance, and firmly tied together with a reef knot. The first pair on the vertex are then tied with sufficient

firmness to fix the lower jaw against the upper one ; and finally the vertical part is kept from slipping forwards, and the horizontal from slipping downwards, by tying the four tails together (this is not shewn in the figure). In adjusting this bandage it is necessary to see that the length of the undivided part fits the jaw to which it has to be applied, and this can only be done by trying it on before it is finally fixed.

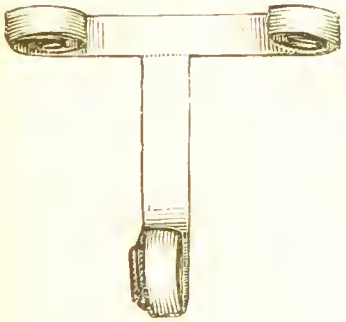


FIG. 30.—*Single* T *Bandage.*

The *single* T *bandage* (Fig. 30) is most frequently used for fixing dressings to the perinæum. Its application there is simple enough. The horizontal part being fixed round the waist, the other end is brought round between the legs and fastened in front.

The bandage can also be applied to the head or elsewhere. For the perinæum, a good average size is five feet for the horizontal piece and three feet for the vertical, and it should be about three inches wide.

For the perinæum, a better pattern than the simple T is the "*double* T" complete (Fig. 32) or incomplete (Fig. 31). The latter is made from the simple one by tearing the perpendicular portion into two tails, except for five inches behind. By using either of these bandages the awkwardness of bringing up the single vertical piece in the middle line in front is avoided. The T is also a very good bandage to apply to the head, to retain dressings. If used *for the head* the vertical strips should be two feet long, and the horizontal one about a yard and a half, to allow

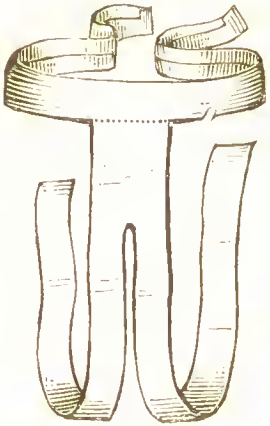


FIG. 31.
The double T *incomplete.*

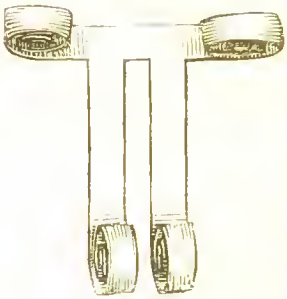


FIG. 32.
The double T *complete.*



FIG. 33. *Double* T *applied to Nose.*

of its going round the head twice or thrice. The width should be three quarters of an inch. *For the nose* a good bandage is the double T applied as in Fig. 33, or the single T with a slit in the vertical part, of the requisite size to partly admit the nasal prominence; while if in addition a slit be made in the middle of the horizontal part of either the single or double T for the mouth, it becomes a good bandage for the application of dressings to *the lips* (Fig. 34).



FIG. 34.—*Double T Bandage for the Nose and Mouth.*

The single or double T, or a T with a small triangular piece inserted at the junction of the vertical and horizontal portions makes a good bandage for the ear, and other modifications may easily be imagined.

OF KNOTS.

Among the smaller accomplishments of the complete surgeon must be reckoned the art of making a "reef," "bow," or "slip knot," or a



FIG. 35.—*Reef and Granny Knots.*

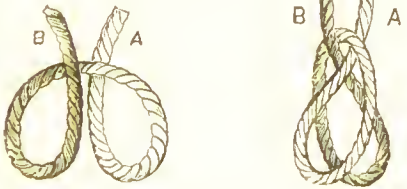


FIG. 36.—*The Clove-hitch Knot.*

"clove-hitch," neatly, quickly, and firmly. The importance of this need not be insisted on, for in surgery

very literally and very often it happens that life hangs on a thread, and the results may be disastrous if this be inseeure. But we believe that to deseribe in words the actual movements of the fingers in making these knots would be only waste of time ; it is a knowledge which eaeh student must aequire for himself by praetiee after he has been shewn how to do it.

In Fig. 35 the left hand eut shews a string tied in a *reef-knot ;* the right hand one in a *granny*. Fig. 36 shows a *clove-hitch*, whieh in the left haud eut is half made, and in the right is shewn eompleted, by plaeing the loop A in front of loop B. Where firmness is wanted, as for the ligature of a vessel, and for all ordinary purposes of knotting, the *reef* is the one for surgeons to use—the *granny*, never—and the dresser must go on praetising the manœuvres until his fingers aequire a perfeet automatic skill, so that he never has to think of their individual movements. The *clove-hitch* is very useful when a pull upon any part is required ; as for example, in disloeations of the shoulder, when a jaek towel is fastened by this knot round the arm. Its great advantage is that it gets firmer the more it is pulled upon, while yet it ean be loosed in a moment. Moreover it has no tendency to slip like a noose. There are one or two ways of making it, all praetieally eoming to the same thing, but the main idea and purpose of the knot ean be gathered from the figure.

We need not waste time or spaee in diseussing the virtues of the bow or half bow, while other knots well known to sailors or builders, as the earriek bend, the bowline, weavers' knot, etc., are not used in surgery.

Chapter II.

Of the Use of Adhesive Strapping.

The use of this material in surgical dressing, for the purposes of mechanical support is steadily increasing, and the number of medicated plasters is being almost daily added to. Of these latter very little need be said, for with few exceptions, their value is still undecided. One or two, however, are certainly of great service in appropriate cases.

The ordinary *adhesive strapping*, diachylon or lead plaster is the form which is still in most general use, and unless it is otherwise mentioned, must be understood to be the material employed. It is sometimes spread on paper, when it is almost useless, but is generally laid on linens of varying fineness, or upon leather. No good purpose is served by using a fine linen, and the best strapping for all ordinary occasions is what is known as "Leslie's Hospital quality," sold in rolls eight inches wide.

Other kinds of plaster are often spread upon chamois leather, or on white basil, and leather should generally be employed when pressure is required, as in strapping an inflamed joint, by reason of its stretching powers.

Recently, a very useful form of strapping, the basis of which is indiarubber, has been introduced, namely, Seabury and Johnson's *rubber adhesive plaster*. Its advantage is that no heating is required, the adhesive surface being protected by a layer of coarse muslin until it is used.

Another very good kind, for small surfaces, is the *isinglass* plaster, made by painting thin silk with that material. It requires wetting only, and is very cleanly.

For clean cut wounds about the face, etc., or in ophthalmic surgery, and in other cases where great

nicety is required, court plaster or gold-beater's skin (a thin film of collodion) is generally used.

If strapping is to be applied directly to a limb, it should be cut in strips and put on spirally, or obliquely, so as to form the half, or a little more, of an 8. It should always be thoroughly warmed first, for which purpose cylindrical hot water tins are generally used, or some gas apparatus. Sometimes strapping is softened by dipping it for a moment in very hot water, this makes it more pliable, and not much less adhesive.

When the strapping is required to accurately adjust or support the edges of wounds, of amputation flaps or the like, the strips should never be stuck first on one side and then pulled over to the other, or "cockling" will certainly occur, but should be cut in pairs, and applied as in Fig. 37, or on some similar

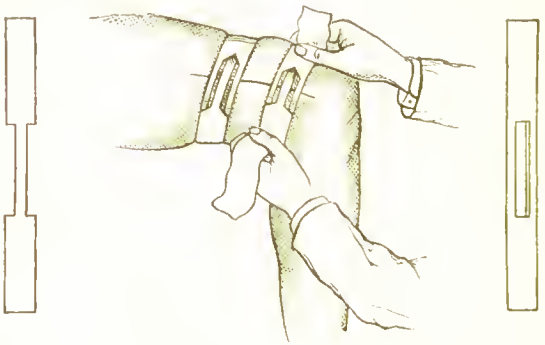


FIG. 37.—*Strapping applied to close a Wound accurately.*

plan. One strip is placed on one side of the wound and the other on the other: the middle parts are slipped the one within the other, and then an even regular pull can be made simultaneously on both sides.

Some special cases in which strapping is a common plan of treatment will here be shortly described.

The case of fractured ribs will be afterwards again referred to. Not only in fracture, but where the thoracic walls have been badly bruised it is often desirable to place them as completely at rest as possible. This may be done very effectually by strapping them as if they had actually been broken.

Enlarged phalangeal joints may often be strapped with common plaster or with the iodine strapping to be hereafter mentioned. The method of doing this is the same as for the larger joints, and does not require a separate description.

The wrist, either for a simple sprain or for the common teno-synovitis of the extensors of the thumb lying over it, may be strapped with strips of linen or leather plaster applied in the same manner as for the knee, Fig. 38; or a single piece of chamois leather may be used in the way which is described below.

Every dresser should know how to *strap the knee joint* efficiently, for it is one of the principal methods of treatment of chronic derangement of this articulation. The usual plan is to apply strips of the plaster, overlapping each other, from below upwards, in half loops of 8, until the whole joint is covered. This may be done well with the plaster spread on linen or



FIG. 38.—*Knee, Strapped (ordinary way).*

holland if great care be exercised, but it is better to use leather, on account of its superior elasticity.

A better way of strapping this joint in the less acute forms of its disease, is one which is little known, and so may here be described in detail.

If the plaster be spread on chamois leather it will be found quite easy to firmly envelope the whole joint with one piece, provided the adhesive material be well spread and well warmed. The piece should be oblong, and large enough to go round the knee and overlap about one inch, and should be from ten to fourteen inches long. After warming it well, the centre of the leather must be very evenly applied to the skin in the popliteal space; one-half of it must then be drawn over the inside and front of the knee, with force enough to produce the pressure required: this will be found to stretch the leather sufficiently to bring it well over the front. The other half is then brought quickly and firmly over the other side. If the leather has been properly warmed, it will stretch so as to overlap for nearly three inches, and the plaster will be applied so closely to the skin that it will follow every wrinkle in it when the knee is flexed, and yet a firm, even compression will be attained (Fig. 39).

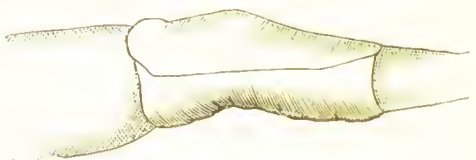


FIG. 39.—*Knee, strapped with one piece of Chamois Leather.*

The ankle, similarly, may be strapped either by narrow strips of linen or leather, or by one broad piece of chamois, the middle of which is applied to the sole of the foot, and the two ends brought up and crossed in a figure of 8 over the front of the foot, and round the malleoli.

Long strips of linen strapping may be usefully employed to support, and to a certain extent, to compress *an enlarged or inflamed breast*. In all cases they should overlap, and should go from below upwards, but, as a

general rule, this kind of support can be much more easily and comfortably maintained by the use of "Martin's" rubber bandage.

It has hitherto been assumed that the strapping has been employed simply for the purpose of mechanical support, or of compression. But frequently the adhesive material possesses in itself (or is applied over ointment possessing) medicinal properties. As examples of these special plasters the *Emplastrum belladonnæ* and *E. opii* are frequently used for their anodyne properties; the *E. hydrargyri* or *hydrarg. è ammoniaco* and *E. potassii iodidi* for promoting absorption.

One of the most effective modes of treatment of enlarged joints, inflammatory bursal enlargements, chronic orchitis, etc., is to cover strips of lint with some absorptive ointment, to lay them over the part and then strap it up firmly with soap or lead plaster. The ointments most commonly used are the various mercurial ones, all the *iodine, iodide of lead*, and *iodide of potassium* preparations, but especially the *camphorated mercurial ointment*, the well-known *Scott's dressing*. The strapping, with the ointment beneath it, should be left on until the latter is absorbed, or until the parts below have shrunk so as to make it loose; it may then be re-applied if necessary.

When strapping has been applied to any part of the skin which is hairy, its removal is always painful, sometimes very much so, unless the adhesive material be softened. This may be done with very hot water, but a better way is to soak a pledget of lint in spirits of turpentine, and to soften and dissolve the plaster from the hairs, as the strapping is turned gradually back.

Chapter III.

Of Splints.

Definition. A splint is *a contrivance or apparatus made of some material, possessing absolute or relative rigidity, which when attached to some part of the body increases its natural stiffness or remedies undue mobility, caused by disease or injury.*

In many parts of the body, an uninjured bone in the neighbourhood of one that is broken, will often serve to keep the fragments of the latter in their place, and in some parts the attachment of ligaments, etc., will serve the same purpose. Thus, in fractures of the fibula, the tibia, if unbroken will make a very efficient splint for it. The same may be said of the ribs, where the muscles and ligaments, which form, with them, the cage of the thorax, very often prevent serious displacement.

A fractured lower jaw, again, may often be kept in good position by keeping the fragments close against the upper jaw, and many other instances might be adduced.

There is hardly a limit to the number of the materials which may be pressed into the service of the surgeon, to form splints in the first instance, in cases of fracture or of some other injury.

The usefulness of cardboard, book-covers, newspapers, firewood, and many other things familiar in daily life, will be mentioned in this connection under the heading of "Immediate treatment of Fractures." But the list is only limited by the ingenuity of the surgeon or dresser concerned.

Surgical splints may be divided into those of some fixed form and shape, and of some rigid material, as wood or iron, to which the trunk or limbs may be attached by bandages or strapping; and those which

are capable of being moulded to injured or diseased parts, to give them the needful support or to remedy deformity. All of these latter possess the property of being soft when applied, and then of setting or hardening.

RIGID SPLINTS.

These are for the most part of wood or iron, though other materials, such as vulcanite, etc., are sometimes used. They may be sub-divided into those of a simple, and of a complicated form.

Plain *wooden splints* are the simplest of all, and will need little description. In most cases they are simply pieces of white pine, of various lengths and breadths, planed, and with their edges rounded off. They are used for fractures of the limbs, or to prevent flexion of joints, as in the common "back splint" of the knee, etc. Not infrequently they are made of strips of wood lined with canvas, on the plan of the kettle-holder splinting, to be presently mentioned, and other materials such as rattan, cane, etc., have been used from time to time.

Angular splints (Figs. 40—43) with or without a hinge

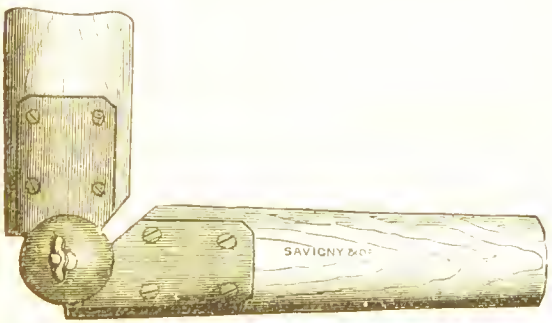


FIG. 40.—*Wooden Angular Splint with Hinge.*

at the elbow, are very useful forms in various injuries of the arm, and like other forms of wooden apparatus, (*e.g.*, the back splint for the knee), are far more comfortable if they are somewhat hollowed out, a proceeding which adds but little to their expense.

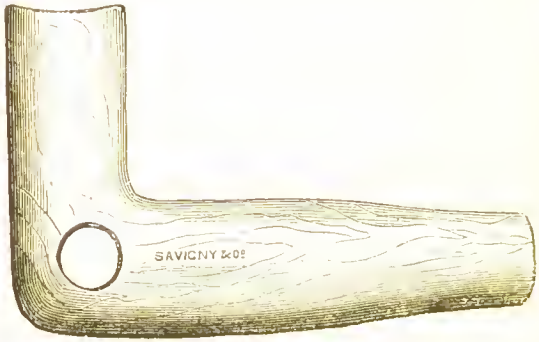
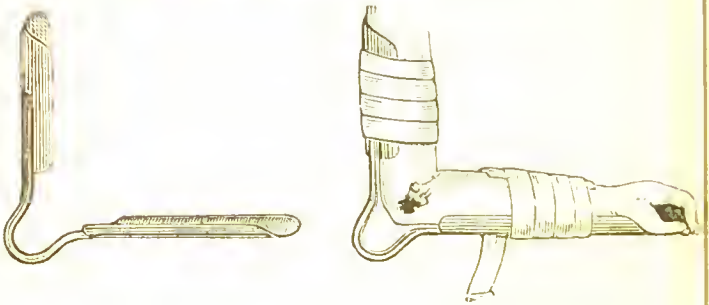


FIG. 41.—*Simple Angular Splint.*



FIGS. 42, 43.—*Angular metal Elbow Splint.*

Figs. 42, 43, illustrate a very useful form of an angular metal elbow splint, lately devised by Mr. R. Jones, of Liverpool.

Of the more complicated splints, in which wood is

the principal material employed, the chief are "Bryant's" for the excision of the hip, fracture of the thigh, etc., "Gant's" for the treatment of genu valgum, splints for fractured patella, and the double inclined plane.

It is often necessary, in cases of compound fracture, or after excision of joints, etc., where we must be able to get at a wound which therefore must not be covered by the splint, to make *an interruption*, as it is termed, and although this is done in iron as well as in wooden splints, it is far more easy in the latter, as in Fig. 44. In making such a splint it is best to choose one as if the necessity for the interruption did not exist, and

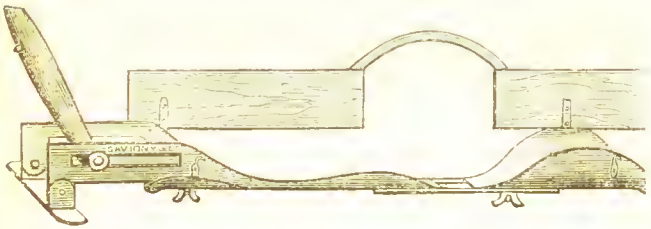


FIG. 44.—*Iron Back Splint, with "Interrupted" Wooden Side Splint.*

then to saw away the parts required to be removed, *after* having fastened on the iron supports.

Iron splints may be simple or complicated; among the former may be mentioned the common angular elbow splint (Fig. 45), generally having a hinge at the elbow, the simple back splint for the leg and thigh, with a foot piece, commonly used for fractures of the leg, generally called "Neville's splint," and the different patterns of that very useful splint, "Maclutyre's" or "Liston's" (Fig. 46), which consists of a movable foot piece, and leg and thigh pieces, with a joint between them, and with some mechanical arrangement of screws or rack and pinion, to alter the

angle at the knee. These can also generally be adjusted for limbs of different lengths.

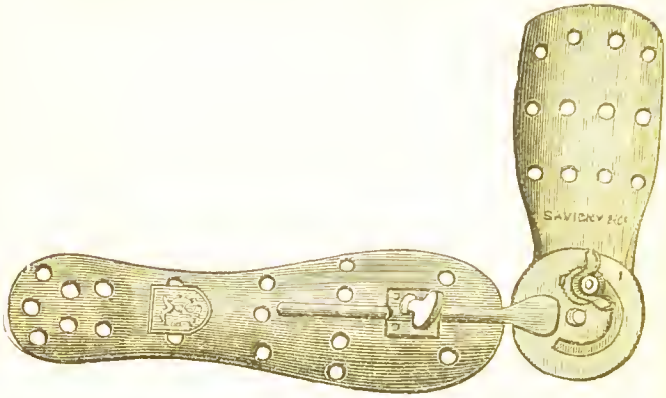


FIG. 45.—*Iron Angular Splints, with arrangements for Pronation and Supination.*

All leg splints for fractures should be furnished with cross pieces, to enable the limb to be swung from a cradle.

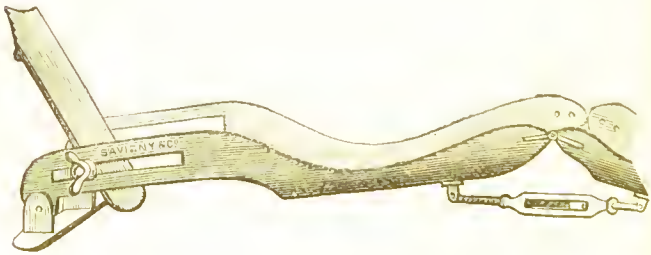


FIG. 46.—*MacIntyre's Splint.*

There are numerous patterns of splints used after excision of the wrist, elbow, and knee, of which examples are given in Figs. 44 and 45.

Splints are also made of tin or some other flexible metal which can be readily bent into any required shape. These are often used in the treatment of talipes.

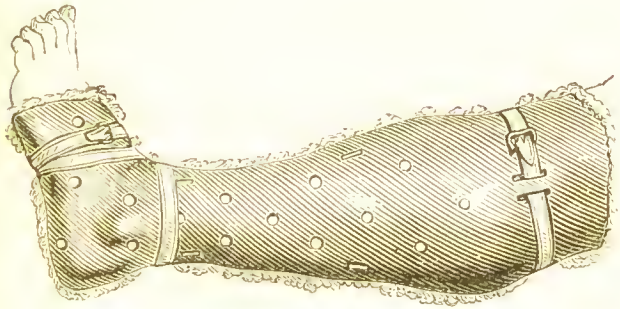


FIG. 47.—*Dr. Guillery's Flexible Splint.*

Fig. 47 is a drawing of a German flexible splint which is now being largely used in this country. The splints are made of different sizes for the arm, forearm, thigh, and leg, and are accurately blocked to the contour of each limb, and retain them in good position in cases of fracture after the displacement has been reduced. They can readily be blocked up differently if any abnormality in the shape of the limb be present. The splint can be procured at most instrument makers. They are named after their inventor, Dr. Guillery.

Kettle-holder Splinting is made by attaching long thin strips of wood to canvas or leather with strong glue. It is made in large sheets, and splints of different patterns can be cut or sawn out of it. Its great merit lies in the fact that it is flexible in one direction and rigid in the other. It is especially used for fashioning splints to partially encircle a limb, as in fractures of the arm, or in combination with a back splint in broken thighs.

All splints before they are applied, should be *padded*,

to avoid injury of the softer parts. This may be done in several ways, and with different materials. Of all paddings, however, the most elastic and convenient is tow, well teased, so that the fibres lie all one way, and with no lumps in it. Soft linen, such as old napkins, makes the best covering for the tow.

For the simple forms of splints, the pads should be made like miniature pillows, and either sewn on with a lace stitch at the back, which is best, or fastened with bands of strapping very smoothly applied (Fig. 48). Pads should always be complete cushions, not layers of tow laid upon the splint and covered.

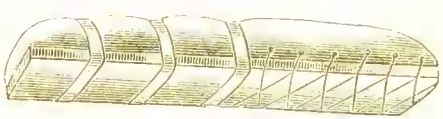


FIG. 48.—*Pad, sewn or strapped upon a Splint.*

Next to tow as a stuffing comes cocoanut fibre, and last of all cotton wool, which is very apt to work into hard lumps. Very good but extravagant pads may be made of several folds of lint.

In all cases where moist or oily dressings, or the discharge from wounds, can possibly soil the pads, they should be covered with some form of oiled silk or with gutta-percha tissue. The former must be sewn on, but the best and neatest way of fastening the latter is to moisten the edges with a piece of lint dipped in chloroform, when they will readily adhere.

Iron splints are usually perforated for the sewing on of the pads, but if not they must be managed like the wooden ones. Before padding them it should be seen that the metal is not exposed by the wearing off of the lacquer, or the cover will be iron-molded.

In jointed splints the pads should be made separately for each part, and especial pains must be taken to have them very smooth and of the proper thickness where they have to protect prominences of bone, such

as the trochanters or malleoli. This is particularly true of the heel, under which the pad should be firm and rather thin, while the tendo Achillis immediately above it should be well supported with a thicker pad. The dresser will be fortunate if he go through his time in the wards without having one of those surgical disgraces "a sore heel" among his cases; but he should heavily reproach himself if he be not sufficiently warned by that example.

Too much pains cannot be taken to select perfectly fitting splints; they should, in almost all cases be a little wider than the limb for which they are chosen: if this be attended to, partial strangulation, through their being put on too tight, is almost impossible. With regard to the various methods of attachment of splints, we need only mention here, that strapping, bandages, and buckled straps of webbing or leather are the chief agents employed; any one or all combined may be found most suitable in each particular case. In bandaging the same rules apply as have been already given, but whatever way of attachment is selected, it should if possible be so managed that the limb can be examined from time to time without disturbing the whole apparatus, and in the case of the extremities at least one finger or toe should be easily got at, in order that the condition of the circulation may be noted. Lastly, complaints of pain or even of discomfort, in parts which are covered by splints, should never be neglected or thought lightly of.

SPLINTS FASHIONED OUT OF PLASTIC MATERIALS.

These splints fall naturally into two divisions; in the first are placed all those which are fashioned accurately to the part, out of a mass or a sheet of material which can be moulded when softened, (generally by heat), and which is then allowed to set. The second class comprises those made by bandaging the part to be splinted, with rollers saturated with a material,

liquid at the time of application, but which afterwards hardens.

Division 1. In this division are included splints moulded from *leather, felt, gutta-percha, cardboard*, etc., the skilful fashioning of which is an important branch of mechanical surgery.

Far too often money is thrown away with very unsatisfactory results, through the mistaken notion that the making of these splints is either below the surgeon's or dresser's dignity, or above his mechanical powers. We have no hesitation in saying, that as a rule, a leather splint for such a case as a chronic enlargement of the knee, or a fractured patella, will be more efficient, if made by one who understands the surgical necessities of the case, than by an instrument maker who must, from the nature of his trade, proceed in a beaten track, and according to a fixed pattern. Something of finish and appearance will no doubt be sacrificed, but the one splint will do its work, the other, very often indeed, will not. With a little care a dresser may easily turn out a very good looking leather splint, without giving any inordinate time or trouble to it. The best leather for the purpose is ordinary sole leather, of medium thickness, arm splints requiring a lighter kind than those for the leg. In all cases the leather should be carefully examined for flaws. The piece being chosen, it must, before softening, be cut out to the required pattern with a very sharp knife.

Patterns for the chief kinds of moulded splints are given in Fig. 49, but in all cases the shape should first be cut out in paper and fitted as nearly as possible to the limb. The figure should then be marked out on the leather before cutting.

Splints may be made of leather for the ankle, knee, hip, spine, shoulder, elbow, wrist, and jaw. The question of spinal splints will be considered in a separate chapter, and inasmuch as among the rest, those for the elbow and knee are by far the most common, and as many of the directions for making them will

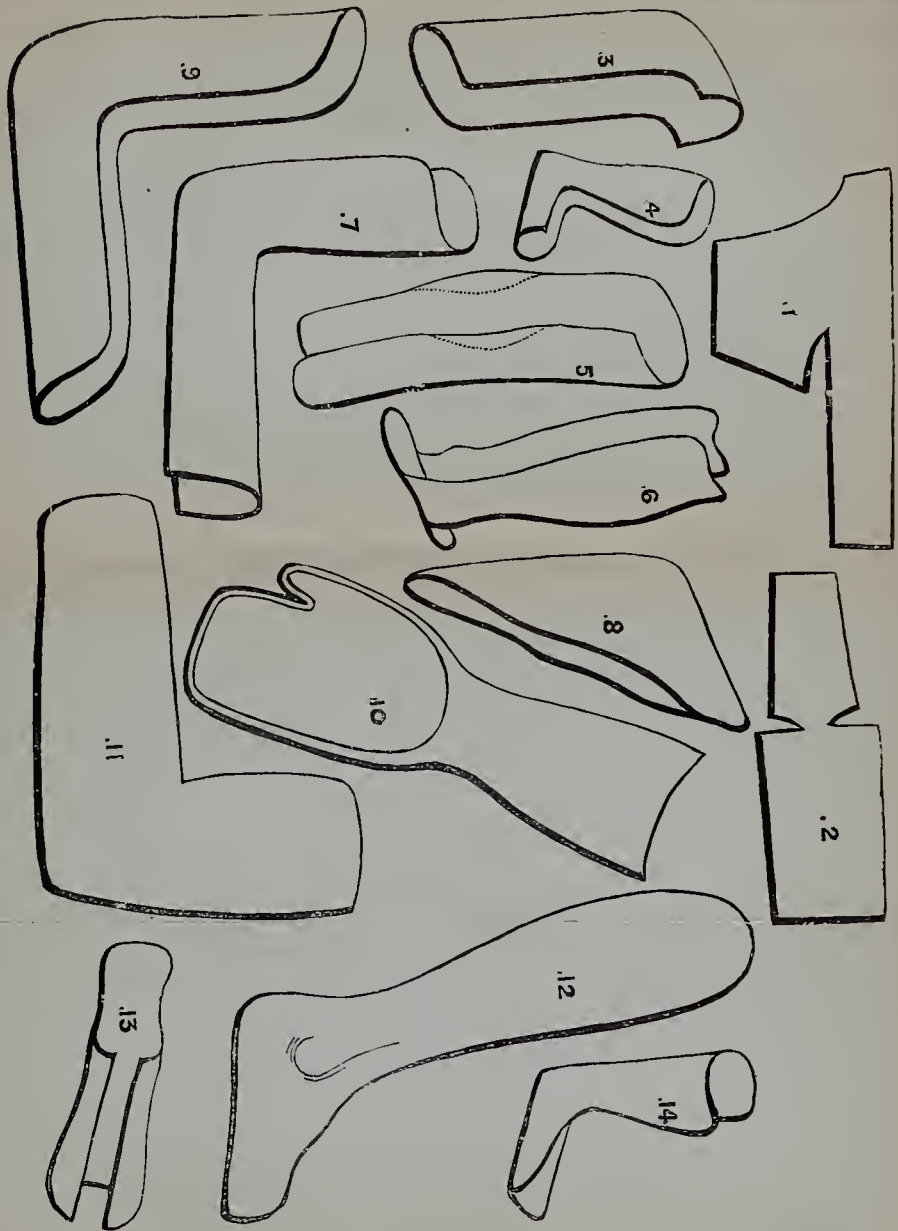


FIG. 49.—*Patterns for the Principal forms of Moulded Splints.*—(See page 44.)

hold good for splints fashioned out of the other plastic materials, these two will be described in detail.

The *back splint for the knee is* a splint which is often required for the treatment of fractured patella in the later stages of union, or for chronic disease of that joint, or after its excision has been performed. The pattern should first be cut in paper (of the shape shown in Fig. 49, No. 5), of such a length as firmly to grasp the leg and thigh, and of a width such as will allow an interval of about half an inch between the two sides of the splint in front. The paper pattern must be carefully fitted to the part, and the leather then cut out after it. This then must be thoroughly softened in a bucket of cold water, which will take from twenty-four to forty-eight hours; if it should be desirable to shorten this time, a tumblerful of vinegar or of dilute acetic acid may be added to the water, when three or four hours will be enough to soften the leather. The splint should then be applied to the limb over a flannel bandage, and bandaged on as firmly as possible, while it is at the same time moulded to fit the curves with all the exactness possible. Too much care cannot be exercised in this, the most important stage of the work. When it is done the leather must be allowed to "set" on the limb, a process which will take at least twelve hours, when it may be carefully taken off and allowed to dry thoroughly. It is then fit to be trimmed and finished by cutting away whatever leather is redundant, or where the edges seem as if they might chafe. The edges too must be bevelled on the inside with a very sharp knife. If it is considered advisable further to strengthen the splint with an iron backing, this may now be rivetted on by a smith.

The lining is best done with chamois leather; it must be cut out from the same shape as the splint, but large enough to overlap it everywhere for about half an inch. The inside of the splint is now brushed over with very hot thin glue, and the chamois leather stuck on. It will adhere very firmly; and the edges must

be turned over and similarly fastened down, and then trimmed to an even width.

The finishing touch is given by punching the necessary holes for lacing and inserting the brass rings with the proper boot maker's tool. If it be desired to polish the leather outside, that may easily be done with beeswax and oil melted together, and rubbed in while warm with a flannel.

In Fig. 50 is shown an ordinary knee splint, finished and applied.



FIG. 50.—*Moulded Back Splint for the Knee, in Leather or Felt.*

There are two principal ways of moulding an angular splint to the elbow, both about equally efficient. The pattern for the first is as in Fig. 49, No. 2,* the arm piece cut long enough to reach to the axillary fold, and that for the forearm, to the wrist. The leather is softened as before, and then, by the bending the arm piece up at right angles to that for the forearm, they will overlap each other at the elbow, the arm ones going outside. The splint thus bent, is moulded by bandaging it on in the same way as for the knee, and may be trimmed, lined, and finished, as has just

* In this pattern the portion for the forearm is drawn too small.

been described. The pieces at the elbow are fastened together by a few stitches of whipcord, or by passing through and bending over, some of the common clips used to fasten papers. This splint, it will be seen, is made of one piece, and may be laced along the middle line in front or fastened there by two or three webbing straps. It is shown finished in Fig. 51. In the other pattern, two pieces of the shape of Fig. 49, No. 11, are cut out, softened, and moulded to the outer and inner sides of the arm and forearm. They may, when finished, be simply fastened round the limb, by webbing or leather straps; or a neater way is to glue the two halves along the back to a broad piece of tape or soft leather, so as to make a hinge: they then can be laced together along the front. The advantage this splint has over the other is that it may be put on and off very readily, but it is more troublesome to make, and is not quite such a firm support.

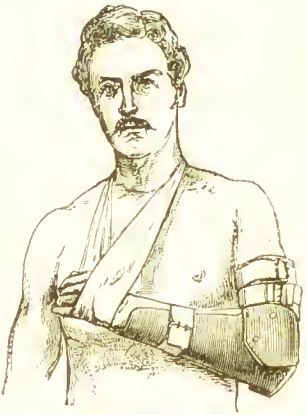


FIG. 51.—*Moulded Elbow Splint.*

It often happens that joints suitable in other ways for leather splints, are too tender to bear the necessary manipulation of moulding. In this case, if it be decided to have one of this kind, a plaster cast must be taken of the limb, and the leather moulded to that ("blocked" as it is termed) when much greater force can be applied.

A material closely resembling leather in its mechanical properties, but more easily applied, is now to a great extent superseding it for moulded splints, both large and small. This is felt saturated with some

resin, in such a way, that while it preserves its porosity, and is but slightly increased in weight, it is rendered quite plastic by heat, but becomes again extremely stiff when cold. The advantages it possesses over leather are its lightness and porosity. Its disadvantages are that it is not so strong, and is more liable to crack or break. The fact that it sets very quickly cuts both ways, being sometimes useful, sometimes embarrassing. There are two chief kinds of this felt at present manufactured; both are sold in two or three qualities. *Hide's porous felt* is, we believe, the older preparation, and is at the present time the cheaper; it is perforated with small holes, which, although an advantage in many ways, takes away from its strength. A resinous liquid is also sold as "Hide's liquid," which, when brushed over ordinary felt, stiffens it, but not so well. The other, "*poroplastic*" *felt*, is made by Cocking; it is stronger and rather heavier than Hide's, and is a very useful material for splints, spinal jackets, etc.

As with leather, the description of the use of this felt in spinal cases is given later. For other splints, the patterns in Fig. 49 are those in most common use; most of them may be had ready made, or they may be cut out of sheets of the material. The best way of softening is by means of a steam chamber, made for the purpose, but an oven will do very well if the felt be first thoroughly moistened, and for most cases, immersion in nearly boiling water will answer the purpose. If softened in this way, the felt must be laid flat and quickly pressed between the folds of a towel to remove the superfluous water, before it is applied to the limb.

The method of moulding is in all respects the same as for leather, save that in consequence of the extreme rapidity with which it sets, the manipulation has to be very quickly performed. These splints may be lined, and eyelet holes punched as in the leather, but care has to be taken not to break the edges. If required, portions of the splint may be left unstiffened, or the

resin may be removed from such parts after moulding by soaking them in methylated spirit.

Next in usefulness to poroplastic felt comes *gutta-percha sheeting*, which is even more readily moulded. It is not however porous, and is uncomfortable when worn next to the skin. In durability it is far inferior to leather or felt; on the other hand it admits of much more complete softening, so that it can be moulded more easily to tender parts, or to parts of a complicated shape.

The sheeting, of about the thickness of sole leather, having been cut out, is softened in water as hot as can be borne by the hands and rapidly moulded to the part, which should first be moistened. If the water be of the proper heat, some care will be required to keep the sheet from losing its shape through undue softening; and if it be too hot this will certainly happen, while on the other hand, water merely "hot" (*e.g.* 100° F.) will not render it sufficiently pliable. The splint will quickly set sufficiently to allow it to be removed without losing its shape, and it should then be plunged into quite cold water, which will give it greater rigidity than it would have if allowed to remain on continuously. It may then be trimmed, and if desirable, lined, and punched for lacing, as before. It will, however, generally be best simply to put it on the limb over a piece of soft lint, and to secure it with webbing straps and buckles, for the gutta-percha is rarely durable enough to make the former proceedings worth the trouble.

Generally, the best way to use *plaster of Paris* is in the form of bandages saturated with it, as will presently be described; but sometimes it may be employed as a moulded mass, after the manner known as the "Bavarian splint." These splints are usually made for cases of simple fracture of the leg, but are not confined to these injuries. Taking the leg as an example: two pieces of flannel or stout canvas are cut out to a pattern which can be accurately got by cutting open a stocking which would fit the patient, along the front of the leg and foot and then spreading it out; or more

roughly, by making "a double" of No. 12 in Fig. 49. The pieces of flannel or canvas are then laid one on top of the other and stitched down in the middle line. The limb being laid upon them, the piece next to the leg and foot is brought round these parts and fastened along the front with safety pins. The corners *only* of the outside piece are then brought up, and pinned or stitched to the corresponding corners of the inner one, so that there is a kind of bag open along the top, on each side of the leg and foot (Fig. 52).

The plaster is then quickly mixed in a basin and stirred with the hand until it is of the consistence of thick cream. It is then poured into the bag on either side, the stitching along the back of the leg of course preventing the plaster from going right round. When enough has been poured in, it is pressed and moulded in all directions by the hands so as to make an even layer of plaster, about a quarter of an inch thick, between the flannel or canvas sides. A roller may then be put on to complete the moulding while the

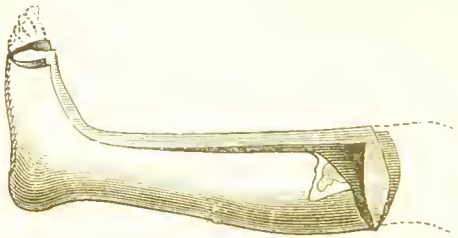


FIG. 52.—*Bavarian Splint (semi-diagrammatic).*

plaster sets, which will take from half an hour to an hour. The splint is then taken off by unpinning the inner layer of the bag in front; there will then be found a kind of hinge behind where the two layers were stitched together, enabling the sides to open. The case is now trimmed and lined, or simply put on over a flannel roller and secured with webbing straps.

Recently, the method of immediate splinting described

by Mr. Croft, or some slight modification of it, has come into very general use, as it has all the advantages of the Bavarian splint in the way of being able to be opened for inspection of the limb, and is yet much simpler. Each splint (for the leg two will be required) consists of two layers of house flannel. The inner layer, which is generally moistened with warm water, is applied to the limb, while the outer one is thoroughly soaked in plaster of Paris cream and put on over it. Both layers are then moulded to the limb while the surgeon holds it in position. *Muslin* bandages are then rolled on so as to thoroughly shape the splints and to bind them together. The turns of the bandage adhere to the plaster, but as the interval between the splint pieces is spanned by the muslin only, this can be cut up for examination of the limb along the upper interval, while it serves as a hinge at the lower. In the case of the leg, the pattern for the pieces of flannel, as in the case of the Bavarian splint, can be got from the flattened out stocking of the patient. Inside and outside splints will here be required, and they must be cut of such a size that they will not meet in front or behind for about half-an-inch. This plan of splinting can be adopted in many different forms of injury, and to various parts of the body.

The plaster in this and all other cases must be very dry; it is therefore a wise precaution to have it put into an oven for an hour before it is wanted.

In the absence of leather, felt, or gutta-percha, a fairly efficient moulded splint may be made from common *millboard* or *cardboard*. After having been cut out of very stout board to the required form it must be thoroughly softened in water, and the details of manipulation may be in all respects similar to those for plastic felt. In most cases, however, the best support will be obtained by cutting the millboard in strips, about $1\frac{1}{2}$ inches wide, softening and then applying them to the limb, one or two at a time, while a roller is at the same time applied, so as to mould and fix

them as well. In this way the strips come to be within the layers of the bandage, and give considerable rigidity to the limb. The splint thus applied has to remain on, and cannot be finished up like the preceding ones, and for this and other reasons the cardboard splints are now nearly superseded by the felt.

There remains to be mentioned one or two materials, occasionally, but more rarely used in general or special surgery, as, for example, *gutta-percha* in mass, *vulcanite*, and *gum resins*. All these are principally used in dental surgery, and their employment in cases of fractured jaw will be described under that head; but the student may be reminded that for splints of delicate construction, materials such as these may be used; so, too, metals, others than those already mentioned, may sometimes be found useful, *e.g.*, lead, silver, or aluminium, the last being specially valuable for its lightness, although its cost prevents its extensive employment.

Division II.—Moulded splints made of roller bandages, saturated with a plastic material. Whatever be the stiffening agent used, the principle is the same for all the splints described in this division, namely, that the part required to be supported must be covered with bandages, into the interstices of which there can be introduced some material which, soft at the time of application, becomes afterwards hard, so that the part is enclosed in an accurately fitting case.

The materials in common use for this purpose are *plaster of Paris*, *gum* and *chalk*, *silicate of potash*, *stearine*, and *starch*; *glue* mixed with spirits of wine, to enable it to dry, has also been used. These may be described in the order just mentioned.

Plaster of Paris, if not the best, is the most commonly used material for this kind of splint, and also forms one important variety of spinal support.

The part to be splinted is first evenly covered with a soft flannel bandage, or some well fitting flannel clothing. The bandages, which should be about two-thirds

the length of an ordinary roller, and 2½ inches wide, are made of a very coarse muslin.

They are prepared by rubbing the dry plaster in powder well into the meshes, and then rolling up loosely. When made they should be kept lying on their sides in a tin box till required.

To make the splint it is only necessary to put the bandages in water till all the plaster is well soaked, and then to roll them on the limb, allowing them to take their own course to a great extent, avoiding reverses, and not attempting to form any regular pattern. The more oblique the general direction of the bandage is, and the more figures of 8 are made, the better. Three layers of the bandage are generally enough to make a firm case.

In all cases where a stiff bandage is applied to the leg, great care must be taken to keep the foot at right angles to it. This is easily done by passing a clove hitch round the big toe with a long piece of bandage, which may be fastened to the head of the patient's bed, or round his neck. When the case has been applied, it must be kept quite still until it has set; this will require from half an hour to three hours, according to the weather, the dampness of the bandages, etc. The setting may be hastened by hot water bottles or proximity to a fire.

Sometimes it is desirable to retard the setting; this can be done by soaking the bandages in mucilage and water. When this plan is followed, some surgeons cut the saturated and moistened bandages into strips, which are laid down, over-lapping each other; the limb is then laid upon them and they are brought round it in order, and the ends crossed in front in a spiral fashion so as to produce the appearance of an 8 bandage.

In all cases when plaster of Paris is used, while the bandage is being put on, a moderate amount of the plaster, moistened, should be rubbed into it, and the hands, well wetted, should be passed up and down to distribute the plaster evenly, and to rub it into the bandage thoroughly.

The *silicate case* is made with ordinary bandages and a saturated solution of silicate of soda, with or without the addition of a little chalk or whiting; it is applied in precisely the same way as the gum and chalk one, so that one description will do for both. In their mechanical properties, also, the two cases are very similar. The silicate is slightly heavier, and perhaps not quite so durable; on the other hand it sets rather more quickly, taking from three to four hours, while the gum and chalk takes from twelve to eighteen.

Gum and chalk. A sufficient quantity of dry powdered chalk, free from lumps, is mixed in a basin with mucilage, until it is of the consistence of gruel. The limb being first bandaged with flannel, (and in the case of the leg or thigh, the foot fixed at right angles with the heel elevated on a block), is carefully bandaged with a common calico roller, the flannel roller extending beyond it for about half an inch. The mixture is then rubbed into the bandage with the hands, so as to permeate it thoroughly. Another bandage is then put on and treated in the same way, and generally a third will be found necessary. The case is then left to dry.

The advantages of a well made gum and chalk case are many. It is lighter when dry than plaster of Paris, and though abundantly strong, has a certain flexibility which prevents it cracking. On the other hand it requires more time and patience in application, and the length of time it takes to set, is sometimes inconvenient. It is however generally preferred by those who are accustomed to put it on.

The stearine case is very clean and very rigid, but it is liable to crack. It is most suitable for limbs which require to be fixed upon splints for some length of time while the patients are confined to bed, or at least have not to move much. Thus, it is a very good way of fixing the leg and thigh on to the splint in cases of resection of the knee. The paraffin is cut up into small chips and heated in a vessel placed in a saucepan full of boiling water, for the wax itself should not be heated above 212° F. Gauze bandages, similar to

those used in antiseptic dressings, are then immersed in the melted wax. The paraffin takes about two minutes to thoroughly penetrate to the centre of the roller. The bandages must then be applied to the limb over a flannel bandage while they are as hot as the operator's hands can bear.

Starch is the least efficient material for making a supporting case, but, on the other hand, it is one which is always ready to every one's hand.

It is applied like gum and chalk, by rubbing starch paste into the interstices of ordinary bandages. Four, or even five thicknesses will be required for any useful degree of support. The limb must be kept very still while the case is drying.

It may be here mentioned that a common roller bandage (*e.g.*, one used for securing fracture splints) has a more neat appearance, and is less liable to be disturbed if a little thin starch paste is brushed or rubbed over it after it has been put on.

Plaster of Paris, or gum and chalk spica bandages are very frequently used in early or convalescent cases of hip disease, or in fractures about the neck of the femur. They are applied like the ordinary spica, but require rather a firmer and longer hold on the thigh. That part of the bandage which goes round the pelvis does not require to be so much stiffened as the rest.

It is often necessary to apply a stiff bandage or case to some part where there is a wound. If the discharge from this be extremely small, it will be sufficient to cover it with dry lint; but if not, an opening or "trap-door" must be made. This is best done with a very sharp knife after the splint is firmly set, a careful note being taken at the time of application as to the exact position of the wound.

It will happen, every now and again, that through chafing, or some other cause, a sore develops underneath one of these splints. In such a case no time must be lost in cutting away the chafing part. This may be sufficient, but very often the whole splint will

have to be removed, and the sore allowed to heal. It is, therefore, very evident that every care must be taken while applying the case to avoid creases or constrictions in the bandages, which may lead to such serious consequences. Another common act of carelessness which may lead to the above result is that of leaving pins within the folds of the bandage.

When plaster or gum and chalk cases have to be removed, a pair of strong cutting pliers (Scutin's) may be used or an instrument devised by Mr. Davy, which is a combination of a knife and a saw, and which is very suitable for the purpose, if the splint is to be cut up along the middle line without other damage so that it may be used again. In other cases a strong jack knife will do, and, on the other hand, if the limb be very tender, it may be best to soak it and the splint in water until the plaster or chalk are sufficiently softened to allow of the layers of bandage being peeled off.

SECTION II.

OF THE SIMPLER WAYS OF DRESSING WOUNDS, BURNS AND SCALDS.

CHAPTER IV.

OF THE DRESSING AND SUTURING OF WOUNDS

For any wound to heal well, the following conditions must be fulfilled.

(1) The wound must be cleansed and kept clean.

(2) The divided tissues must be accurately re-adjusted and retained in position.

(3) The parts must be kept at rest.

(4) All effused fluids must be able to escape, and must be taken up on escaping. The primary blood effusion must be arrested completely, and the wound in almost all cases, must be covered and protected by some dressing material.

1. *The cleansing of the wound.*

This will be necessary, even when it has been inflicted with a perfectly clean instrument, lest blood clots remain in it. For ordinary cases, the thoroughness with which the washing is performed is more important than the fluid which is employed. A lotion of carbolic acid (1 in 40 to 1 in 100), or of Condy's fluid, or of perchloride of mercury (1 part in 2000), are about the best to use.

If there be any suspicion that septic or poisonous matter has been introduced into the incision (*e.g.* in a dissection wound), it should be thoroughly swabbed or syringed out with a 1 in 20 carbolic lotion, or one of chloride of zinc, in the proportion of 40 grains to the

ounce, or of perchloride of mercury of the strength of about 1 part in 1000. The process of cleansing, of itself tends greatly to check the capillary oozing, and hæmorrhage from other sources must be thoroughly arrested before any attempt is made to close the wound.

2. *The adjustment and closure of the wound.*

(A) *Of its deeper parts.* With the exception of the parts which are necessarily separated by the presence of drainage tubes, the adjustment and replacement of the divided tissues must be carried out throughout the whole extent of the wound, and if possible, as perfectly in its deeper parts as on the skin surface; for upon this the manner of healing, as well as the appearance when whole, will greatly depend. But the means at our disposal for keeping the deeper parts together after replacing them, are somewhat imperfect. In most cases the support and pressure afforded by pads and bandages put on outside the wound are trusted to keep the sides together, and if these will suffice, so much the better. But in many instances, and especially in plastic operations, it is necessary to fix the parts more securely, either by sutures, passed far below the surface (deep sutures), or by needles or hare-lip pins passed at a similar depth.

Deep sutures. If the depths of the wound have to be kept together in this way, it must be because there is a tendency for the parts to separate. There will, therefore, be *tension* on the sutures, and unless some precautions are taken they will speedily cut out. All the contrivances which have been devised to prevent this have for their object that the sutures shall pull upon an area of skin at the margin of the wound, which is shielded in some way from the direct pressure of the wire or thread. For this purpose, the suture, which is passed through the wound at the depth desired, enters and emerges from the skin at a little distance from its edge, and is then fastened to a piece of quill or catheter, or passed through a perforated ivory cylinder or piece of sheet lead or zinc cut to the requi-

site size, or shaped as a stud or button. The illustration (Fig. 53) will show without further words the general principle of these fastenings, of which the details may be modified in many ways.

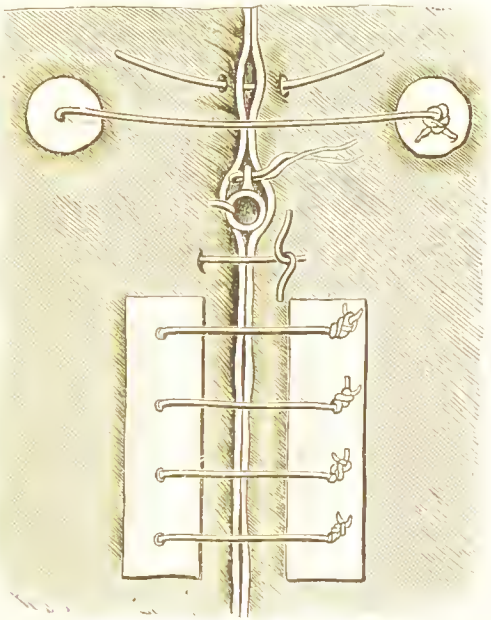


FIG. 53.—*Illustration of some forms of Deep and Superficial Suture, and of the Fastening of Drainage Tubes.*

A good plan to secure the wire after it has been passed, whatever shield has been used, is to close a split shot (like those used in angling, but rather larger) over it.

Deep sutures are easier to remove than to put in, for a pair of scissors placed between the skin and the shield on one side will be able to cut the wire short

off there, and then it can be drawn out from the other side.

Hare-lip pins are steel pins which may be passed across the depth of a wound, entering the skin a little away from the edge on one side, and coming out at a corresponding distance on the other. Silk or worsted (the latter is to be preferred), is twisted over the protruding ends, so as to bring not only the deeper parts, but the skin surfaces into apposition. The point and head of the pin are then nipped off with a pair of cutting pliers, made for the purpose. Two little bits of lint should be put underneath the ends. Hare-lip pins are generally removed at the end of from 24 to 48 hours; they must not be *with*drawn, but drawn *through*, by seizing the end off which the point has been nipped, and making steady traction with rotation in the axis of the pin, but without working it from side to side. If possible, the silk or worsted threads, matted together with blood, should be left as a scab over the wound, after the pin has been taken out.

(B) *Closure of the lips of the wound.* Superficial sutures are for the accurate adjustment of the divided skin surface, and of the tissues near it; in most wounds they are the only ones required. No strict rule can be laid down as to the depth at which they should be passed, but it is often convenient to put them deep enough to arrest bleeding from vessels in the cut edges of the wound.

Wire, silvered, or of silver, silk, catgut, and occasionally horsehair, are the materials chiefly used for sutures, and of these, general preference must be given to silver wire. Silk and horsehair are used principally for wounds about the face.

Whatever be the thread used, the interrupted suture is almost the only one practically employed. Each point is secured separately, by twisting, if it be of wire, or by tying in reef knots in other cases. Thin wire may also often be tied. In any case, the twist or knot should be at one side, and not over the line of

the wound. The actual skin surfaces should, if possible, be brought together exactly, but it is better that the edges should be a little everted than inverted. A little inversion is often overlooked at the time of adjustment, and the result is an unsightly depression.

The number of sutures must be just as many as will close the wound throughout; fewer will not do, and more are needless foreign bodies. So long as stitches are not doing harm, there is no limit to the time they may be kept in, but as soon as there is any tension, or area of inflammation around them, they are better away, lest they should be retaining discharges.

Silk sutures require only to be snipped and removed with forceps, but wire ones should always have the little hook which will be found at the end which is to be pulled through the wound, carefully straightened out or cut off. No more needless pain can well be inflicted than that caused by neglect of this small precaution.

Adhesive strapping may be used to relieve tension which would otherwise be borne by the sutures alone, or may be the sole means employed to close a wound. In either case care must be taken to avoid puckering, and the best way to do this is by cutting the strips as shown in Fig. 36. If the adjustment be carefully made, there is no better way of closing a wound. The widely diffused support of the plaster is extremely useful, but no wound, except very small and clean cuts, should ever be completely closed over with strapping; a drop of pus thus shut in may work very great mischief.

There only remains to be mentioned a mode of closing small wounds, especially about the face, by *collodion;* the ordinary, or the flexible kind may be painted over the wound or applied upon a piece of lint, and by its contraction a close apposition may frequently be attained.

3. *Arrangements for rest, i.e.*, for retaining the wound surfaces in apposition. It is not necessary to enlarge on the importance of this point. It will be

understood that a wound can hardly heal unless it be kept at rest, and also that the means of securing this rest must vary with every case.

4. *Arrangements for the ready escape and absorption of all exuded fluids, and for the covering and protection of the wound.* The means to be adopted to secure the fulfilment of these conditions, include the different ways in which wounds may be drained, and the several "dressings" that may be put on them.

There will be in all cases some fluid exudation, whether a wound has been closed before the bleeding has stopped or no, and provision must be made for its escape, except in wounds which are at once small and perfectly healthy.

It must be understood, therefore, that most wounds are to be drained in some way or another. The more common of these ways are now to be considered.

The materials generally used for drainage are, indiarubber tubing of different sizes, flexible tubes of coiled up wire, tubes of decalcified bone, and wisps of horsehair, or catgut; but almost anything of the nature of a tube or a thread, if it be in itself unirritating, may be placed in a wound to facilitate the escape of the discharges.

But the drainage material which will probably be for long in most general use, is *indiarubber* tubing, of which special kinds are made, of various sizes, and perforated at frequent intervals.

As the whole object of a drain is to prevent fluid remaining within a wound, no exception can be made to the rule that all surgical cavities are to be drained *from the bottom*. The place of exit for the drain should therefore be the most dependent part of the wound, unless, as is often advisable, a separate aperture is made for the tube alone. Often, too, it is necessary to pass the drain right across the cavity, either by making it enter the wound at one end and leave it at the other, as may be done in amputations of the limbs, or of the breast; or by making apertures, and counter apertures.

The tube is apt to accidentally slip in or out; this may be prevented by threading a common needle with silk or thread, and passing it through the tube wall (see Fig. 53), from ¼ to ½ an inch from its end. The ends of the silk may be left about two inches long, and fixed to the skin surface by a little bit of strapping.

The tube should be as small as will suffice to carry away the discharges, and it should be removed as soon as it is safe to do so; when it cannot be withdrawn altogether, it should be shortened up from day to day. But it is impossible to lay down any strict rules; in such a case as an amputation of a limb, or of a breast, healing well, in from three to five days a channel will have been formed which may be safely left to itself, while in a chronic abscess, the tube may have to be left in for months; but in any case it is a safe rule to follow, that every time the dressing of the wound is changed, the tube must be taken out and syringed through with carbolic lotion.

The term *surgical dressings* is used to express the materials and medicaments which are put over a wound to cover and protect it, and to forward its healing. These may be conveniently divided into *dry*, *watery*, and *oily* dressings.

The medications used may have for their purpose the prevention of decomposition, or the maintenance of simple cleanliness, or some stimulation of the wound; or a cool, a warm, or a moist atmosphere may be desired, or simple greasiness of the surface. But whatever be the nature of the dressing, it must before all fulfil the indications of cleanliness, and absorption of the discharges.

Just as in former times it was believed that a simple fracture could not unite, unless healing salves of various kinds were applied to the skin, so even up to the present day, many seem to find it difficult to remember, that the nature of wounds is to heal, and that nothing applied to a wound can of itself heal it, though many things can be done to retard or prevent

the healing proeess. In faet, the results now desired, are almost absolutely negative ones, such as the avoidanee of movement, of irritation, or of tension, the removal of diseharges, and the like.

But, in most eases some kind of applieation will be required, and the nature of the dressing does in many eases affeet the course of the repair. Thus granulations will often beeome large and flabby under earbolie oil, and again, small, and prone to bleed, under the use of ehloride of zine. A ehoiee, therefore, has to be exercised, but experience alone will give the power of judieious seleetion.

For the purposes of deseription, some elassification of wound dressings must be adopted, and the following may probably be found eonvenient. We shall first divide them into dry, watery, and oily dressings, and then arrange the drugs and materials used under eaeh head, according as to whether they are ehosen beeause they are non-irritant, anodyne, antiseptie, or stimulating.

Simple scabbing. In a healthy atmosphere, even large amputation wounds, will heal well if they are simply exposed to the air with no dressing whatever upon them. The effused blood and lymph form a erust, under which repair progresses, and if care be taken that no discharges are retained, the results of this almost absolute negleet of the wound are very good, especially in the country, as in eottage hospitals. But the method is not generally adopted, beeause of various inconveniences, of whieh the ehief is, that no support is afforded to the limb generally, or to the deeper parts of the wound in partieular, where the pressure of a bandage or pad is often very desirable.

But this objeetion does not apply to the dressing by dry absorbent pads, a plan espeeially advocated by Professor Gamgee. The principles of this method are "dry and infrequent dressings, immobility, and pressure."

A great many different materials have been used for pads in this form of dressing, and, sometimes one,

sometimes another, will answer best. What is wanted is a proper firmness, combined with elasticity, so that a moderate restraining pressure is kept on the wound. At the same time the material must be *absorbent*, to provide for the infrequency of dressing. Pads of lint, of salicylic wool, or cushions of the one lined with the other, marine tow, or lint, oakum, boracic lint, tenax, sawdust bags, wood wool, carbolic gauze, and sponges, have been used, and many more. Of all these, the best for general use, seems to be the salicylic wool, made into a pad, and covered with gauze, but sometimes sponges will be found very useful; thus they may be applied to either side of an amputation wound, or placed in the axilla after amputation of the breast. A wound dressed on this plan must have its edges, and if necessary its deeper parts, adjusted with the appropriate sutures, and provision must be made for its drainage; secondly, the mechanical fixation of the neighbouring parts should be secured by moulded splints, or plaster of Paris bandages, or similar contrivances for the fulfilment of the indication of immobility; and thirdly, the parts immediately concerned in the wound must be covered, and lightly but firmly pressed upon by the absorbent pads, secured by bandages.

If the discharges from a wound thus treated are only moderate in amount, there will be no necessity to change the dressings for some days, and no method gives better results in the case of large healthy wounds.

Other forms of dry dressings there are which have proved valuable in the hands of those who advocate them, such as the dry earth plan, etc., and layers of dry boracic lint, fastened on with a carbolised gauze bandage, will often be found to give as good results as any of the most complex methods.

A dry anodyne dressing of opium powder and powdered bark in equal quantities is sometimes used in cases of painful cancerous ulceration. It may be dusted on the parts, and covered over with layers of boracic lint or tenax.

Iodoform in powder is often employed as a dressing to incised wounds, being freely dusted on the part, underneath whatever other dressings may be chosen. A small dredger, such as is used for Keating's insect powder, or a pepper castor is a convenient receptacle for it. It may also be used as an ointment mixed with vaseline, or as an ethereal solution, which, painted on, leaves it as a thin pellicle, upon the evaporation of the ether.

Wet dressings. This class of application is a very large one, and comprehends all lotions, tinctures, hot or cold compresses, and poultices; every dressing in short, by means of which the surface of wounds may be kept moist. In the great majority of cases, the moistening fluid is applied by soaking pads or strips of lint in it.

Before all other wet applications, must be placed the common "water dressing." This simply consists in the covering of the wound with a few layers of lint moistened with water, or with a weak watery lotion, renewing the moisture when necessary. Very often it will be found that wounds heal more kindly under this treatment than under any other. In order to check the too rapid drying of the lint, a piece of oiled silk, or gutta-percha tissue, may be put over it, but this must be smaller all round than the lint, or the dressing will be changed from a cool and moist, into a warm and steamy one, in fact, into a poultice.

Watery lotions are generally applied in the same way as the simple water dressing, but they may also be useful for irrigation or immersion.

The following are examples of the wet dressings or lotions which are used in the dressing of ordinary wounds. Some are simply non-irritant, others are stimulant, or antiseptic, or anodyne, but no regular gradation is possible.

LOTIONS OF

Permanganate of Potash (Condy's Fluid)	Chloride of Zinc
Carbolic Acid	Chlorinated Soda
	Liq. Chlor.

LOTIONS OF—*continued*.

Boracic Acid	Iodine
Sub-Acetate of Lead (Goulard Water)	Liq. Carbonis Detergens
	Sanitas
Sulphate of Zinc	Terebene
Chlorate of Potash	Chloralum
Alum	Sub-Acetate of Lead with Opium
Nitrate of Silver	

Belladonna.

It will, of course, be understood that many of these may be used in several different strengths, and for other purposes than for dressing incised wounds.

Irrigation is a form of wet dressing which is sometimes used for clean wounds, especially when they are near joints, but it is much more often adopted for foul or sloughing ulcers, under which head it is again mentioned. Its great drawback is the risk to the patient of catching cold from the exposure, which can often hardly be avoided.

To set up an irrigation apparatus, all that is required is an arrangement by which a constant drip of

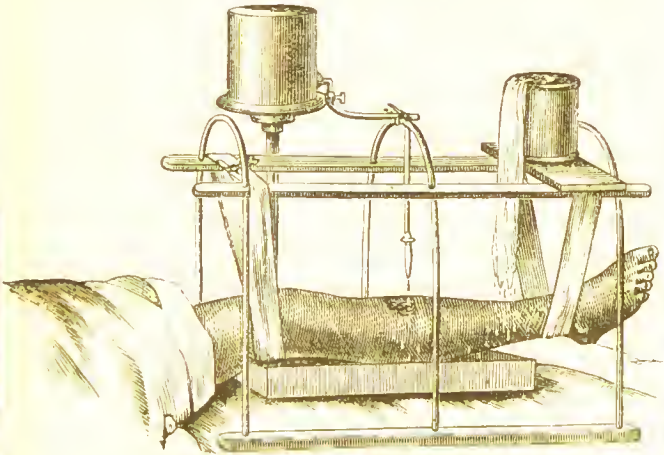


FIG. 54.—*Methods of Irrigation.*

water, or of some lotion, can be made to fall upon the wound, as shown in Fig. 54. This may be done by suspending a vessel over the wound, properly fitted with a tap and india-rubber tubing, or the tube may be allowed to act as a syphon. In either case the difficulty is to get the drip to be sufficiently slow, and quite as good a plan, is the simpler one of hanging one or two strips of lint from a vessel supported above the wound. The fluid is evenly distributed, drop by drop, by the strips, which act as syphons by the capillary attraction of their fibres. It will be necessary to put some pan or basin beneath the wounded part, and the bed must be kept dry with water-proofing; but there is always some slopping, and the patient had better lie in blankets.

Plain water, Condy, carbolic, boracic, or iodine lotions, are the fluids most frequently used for irrigation, and, although, if this treatment be continued for many days, the granulations are apt to become sodden, no dressing will more efficiently clean a wound; immersion of the wounded part in a bath of warm carbolic, or Condy, for many hours, is often also extremely beneficial.

A clean cut wound should never require *a poultice*, the special advantage of which is the relief, the warmth and moisture afford in conditions of inflammatory tension. The different ways of making poultices are described in the following chapter.

The indications which call for a poultice, may be met, though perhaps not quite so well, by water dressing, *completely* covered with gutta-percha tissue, or oiled silk, or by spongio-piline, cut to the requisite shape, and soaked in either hot or cold water. To such an application the term a "compress" is applied.

Certain alcoholic tinctures, generally freely diluted, are in common use as wet dressings. Of these, Friar's Balsam (Tinctura Benzoinæ Co.) should be mentioned as an admirable stimulant for wounds which are slow to heal. It is applied by soaking pads, or strips of

lint in the tincture, and is probably the best of the preparations of aromatic gum resins.

Whether the tincture of arnica has any especially beneficial action on bruises, contused wounds, and the like, beyond that of the spirit it contains, is doubted by many, yet it would be singular if so widespread a belief as that which prevails as to its virtues, were quite groundless. It is, however, certain that even very weak lotions made with this tincture will sometimes create quite an extraordinary amount of irritation, which may run on into true erysipelas ; and the drug certainly possesses no merits to compensate for the drawbacks of such a risk.

Tincture of iodine, freely diluted, is often used as an antiseptic and stimulant application ; it makes an admirable irrigating fluid, especially for foul wounds.

Coming now to the *oily and greasy dressings ;* olive oil, pure and simple, would be largely used, on account of its absolutely non-irritant qualities, were it not so apt to become rancid ; but when carbolic acid is added to it, it forms an application to wounds which is universally appreciated. Carbolised oil usually contains one part of the acid to 40 of oil, but other proportions may be found more useful in special cases. In the proportion of 1 in 15 or 1 in 20, it lowers local sensibility without having the escharotic properties of the pure acid or its stronger solutions. It is generally used by soaking pads or strips of lint in it.

The oil of eucalyptus, thymol, or terebene, may also be mixed with olive oil, and used in precisely the same way as the carbolised oil. They are all good dressings, although they have not yet been shown to be in any way superior to carbolic oil ; any of them, the eucalyptus oil especially, may be used when carbolic acid is contra-indicated.

All these dressings, if continued for long, are apt to make the granulations large and flabby ; they should then be changed for some astringent lotion, such as a solution of the sulphate or chloride of zinc.

Castor oil is rarely applied externally, except in

injuries to the eye, where its viscidity and blandness make it very useful.

Ointments of various kinds are largely employed as dressings for wounds, especially in the later stages of their healing. Some are chosen for this purpose because they are non-irritant, as the ung. simplex, or ung. spermaceti, or because they have more or less stimulant properties, as the ung. zinci oxidi., or the ung. hydrarg. nitroxidi, diluted with an equal quantity of vaseline or lard.

Vaseline, though in no sense an oily material, may conveniently be classed with them. It is a clean and bland dressing, and serves also as a basis to which various drugs may be added, so that they can be applied as ointments. Some of these will be mentioned under the headings of the dressings of ulcers, bed sores, syphilitic sores, etc.

Speaking generally, ointments are most conveniently applied by spreading them on lint or on old rags.

Chapter V.

On the Making of Poultices, Fomentations, etc.

Poultices are applied in *surgical* cases when a superficial inflammation is to be allayed, the process of suppuration hastened, or when any wound or sore has assumed a sloughing or otherwise unhealthy character. In *medical* cases their useful action is less direct, inasmuch as they are mainly intended to reduce an inflammation of parts at a distance from the skin surface to which the heat and moisture are applied. But in all cases the immediate object to be served by putting on a poultice is to warm and moisten the tissues with which it is in contact. The manner of its action is partly mechanical, for by relaxing the tissues, pain and tension are reduced; and partly physiological, as it affects primarily the circulation of the part poulticed, and secondarily the tissues or organs at a distance.

A great variety of materials have been used at one time or another for making poultices, such as carrots, turnips, potatoes, etc., but we shall here consider the following only:—

1. Poultices of crushed linseed meal.
2. ,, ,, ,, with charcoal.
3. ,, ,, ,, with mustard flour.
4. ,, oatmeal.
5. ,, bread.
6. ,, starch.
7. ,, ,, with iodine (Marshall's).
8. ,, bran.
9. ,, yeast.

The common *linseed meal poultice* is the one in the most general use, and is the easiest to make. The

crushed seed, not the ground linseed flour, should always be chosen, for the former still retains a good deal of oil which gives a surface to the poultice mass and prevents it from sticking to the skin.

All that is necessary to make a good linseed poultice is to see that the water is boiling to begin with, and to waste no time in the mixing. The general plan is to scald out a pudding basin, to put into it the linseed, and to add boiling water gradually, stirring the mass with a warm spoon; or if it is preferred, the water may be put first into the basin and the meal gradually added; or again (and in this way all cooling of the poultice mass during mixing is avoided), a sufficient quantity of water may be kept boiling in a saucepan upon the fire, and the linseed gradually stirred into it. In any case, when the proper consistence has been reached, the contents of basin or saucepan should be emptied out upon a piece of old linen or cotton stuff, of the shape of, but a little larger every way than the poultice required, and quickly spread with a spatula, or large knife (an ivory paper knife does well), which must be kept well wetted with boiling water, until it is everywhere about $\frac{1}{4}$ inch thick. This spreading should have distributed the mass evenly over the stuff, up to about an inch of its edges: this inch must now be neatly turned over upon the margins of the poultice to which it will adhere.

Another good plan is to card out tow and fashion it into a bed for the poultice mass. The manipulation of the tow requires some practice, and can hardly be described in words, but it forms a very light non-conducting backing.

If the mean has been hit between sloppiness and dryness, the poultice should now be able to be folded up or handled freely without coming to pieces, and its surface should be smooth and non-adherent to the skin, to which it should be, when first made, still too hot to be applied.

If it be desired to keep a poultice hot for a little time before it is applied, or if one has to be carried for

any distance, it is best to fold it up and place it between two hot plates.

Poultices should be applied as hot as they can be borne, and to get the full benefit of them they should be changed at least every two hours, for whatever they are made of they soon get stiff and cold; as a rule, every three or four hours is considered to be the time for changing poultices, and in hospital it is perhaps hardly possible that it should be otherwise. But under no circumstances should eight or ten hours be allowed to pass, for by that time the poultice will have become sour.

Of whatever kind the poultice may be the surface of the mass must be placed upon the skin itself, without the intervention of any woven stuff, even of the thinnest muslin.

If oiled silk or oiled paper be placed over the back of the poultice it will retain its heat and moisture better.

All old poultices should be burned directly, never allowed to remain in a ward, or be thrown into a dust-bin.

An aseptic character is thought by some to be given to poultices by making them with condy, carbolic lotion, sanitas, or liq. carbonis detergens, instead of with simple water. Of these fluids, the two last are the best, and are certainly of some use in the case of foul or sloughing wounds which are being poulticed.

Charcoal Poultices. A more distinct antiseptic action is supposed to be exercised by poultices made of three parts of linseed to one of charcoal in powder, but the powder used in this way has much of its disinfectant powder destroyed, and it is much better to sprinkle it in the dry form over the wound, and then to apply an ordinary poultice over all.

For counter irritation mustard flour may be added to the crushed linseed in varying proportions (generally equal parts of each), and the poultice made as before. These "mustard plasters" are largely used in domestic medicine, but they are often a useful stimulant in

surgical cases, as in cold, or callous ulcers of the legs.

Such applications as iodoform, or opium in powder, are sometimes dusted upon the surfaces of poultices, or laudanum, or the tincture of belladonna, may be sprinkled over them for anodyne purposes, but this is not generally considered a good way of administering such local remedies.

Oatmeal poultices are commonly used in Scotland, but more rarely in the south of England. They are somewhat heavier than linseed ones, but in the respect of caking when cold, etc., they are practically identical; they are also made in just the same manner.

Bread poultices are also in very common use, although they are rather difficult to make of the right consistence, neither sloppy nor crumbly, and so as to be non-adherent to the skin. Their lightness is their chief merit.

The readiest way, but one which will do only for small poultices, is to take a slice of stale bread without crust, to place it into a scalded basin, and pour boiling water upon it. The basin should then be kept hot upon the hob, or in an oven for a few minutes. Then the water should be poured off it as completely as possible, and the remaining bread pulp spread out upon linen or tow as in the case of linseed. But no large bread poultice of any consistence can be made in this way; if this be required, the crumb of a very stale loaf should be passed through a grater until it is like coarse flour. The poultice can then be made in the same way as a linseed one, and if spread out to a similar thickness will be a much lighter poultice. The lack of any natural oil in the bread must be made up by pouring a little olive oil over the surface of the poultice when made, or it will stick to the skin.

A starch poultice is non-irritant and keeps its heat well. A stiff starch *paste* should be made with cold water in a basin, and then enough boiling water added to bring this to a proper consistence, the mass being then spread upon linen.

Starch and iodine chemically combine to form a mass which may be termed a cold poultice, and which is a very useful application for syphilitic ulcerations. It is made by adding ℥ss liq. iodi to a hot starch jelly, which itself has been made by adding ℥vj of boiling water to ℥ij of starch.

Bran poultices are made simply with bran and water; they are light, but do not retain heat well.

Yeast poultices are the last we shall mention. One form consists simply of a mass of warm dough which is at the time fermenting through the action of yeast added to it (either of brewer's yeast or any other kind), the quantities required being roughly 14 oz. flour, 6 oz. brewer's yeast, 6 oz. hot water (*i.e.*, 100° F.).

Another form of yeast poultice is made by spreading warm yeast over an ordinary linseed or bread poultice. Both kinds have been supposed to exercise a special cleansing action upon sloughy wounds, gangrenous parts, and the like.

A fomentation is made by soaking a piece of flannel in boiling water, and wringing it as dry as possible in a warmed towel. Some few people, laundresses especially, are able to perform this wringing with their unaided wrists, but for most it will be necessary to use a set of wringing sticks. These consist of two pieces of stick-like rulers, about 2ft. 6in. in length, passed through the ends of a round towel, about 2ft. 6in. by 10in. When the soaked flannel is picked out of the boiling water it should be allowed to drip for a few seconds, and then it must be placed in the centre of the towelling, and the whole twisted up by the leverage of the sticks, until no more water comes away. This should take but a few moments. Another good way is to sew the ends of the flannel together and to pass the sticks through, before the boiling water is poured on to it. It can then be lifted and wrung without loss of time, and put into a dry warm towel.

For a simple fomentation the flannel should just be applied to the skin as an application of warmth and moisture, some non-conducting stuff being wrapt

around outside. But these fomentations are often used with some counter irritant or anodyne ; thus laudanum, or the tincture of belladonna may be sprinkled over the flannel, or turpentine is used more frequently still. This last forms the common turpentine stupe, so often used for lumbago. In all cases if the fomentation is to produce its proper action, the flannel must be wrung dry out of boiling water, and if the wringing be not effectually performed, it is quite likely that some scalding of the skin will take place.

Chapter VI.

The Dressing of Burns and Scalds.

For the purposes of the dressing of these injuries it will be convenient to distinguish burns which are important by reason of their extent and position, from those which are important by reason of the depth of tissues destroyed.

To the first class belong all extensive scalds or burns, especially those occurring on the chest, abdomen, or head: to the second, burns, or more rarely, scalds, wherever they may occur, in which the whole depth of the skin has been destroyed, so that on healing, a contractile cicatrix is the result.

1. *Burns or scalds important from their extent and position.*

No class of injury produces such grave depression of all the functions of life, such profound "shock," in comparison with the actual damage to the tissues, as does a large burn or scald. This depression occurs wherever the injury may be situated, and is in direct relation to its superficial extent; but it is especially marked if the chest or abdomen be burnt, and is more profound in children than in adults. It may moreover be aggravated by exposure, or diminished by protection from the air, to a very marked extent.

This primary shock is often very prolonged, and when it passes off is apt to be succeeded by a congestion of internal organs, as of the lungs, intestines, cerebral meninges, kidneys, etc.; or later still, the patient may have to go through an exhaustive process of suppuration.

The periods of greatest risk to life in these cases are, first, during the few hours immediately succeeding the injury, when it may be doubtful if the patient can rally from the primary shock, and after that, during

the period of internal congestion or inflammation, which rarely exteuds beyond the first fortnight.

The best treatment and dressing for severe superficial burns *in the first instance* will greatly depend on the resources which are nearest to hand, for the air must be excluded from the burn as quickly as possible, and it should be covered with some light non-conducting material. Fatal damage may be done in a few moments by exposing a badly burnt chest or abdomen to the air before anything is ready to cover it; but oil or flour, or powdered whiting, or cotton wool, are materials which are in such common use, that any one of them can be readily applied in an emergency.

The clothes must, therefore, be cut away from the burnt surface with the utmost care, so as not to further damage the tissues beneath, and over and around the wound, flour or whiting should immediately be thickly dredged, or olive oil freely poured, and then the whole part should be wrapped in cotton wool.

While this is being done, and afterwards, attention must be given to the condition of shock, which will generally be present. The patient must be kept warm, and should lie with the head low. Hot water bottles, etc., may be used, and ether, or sal volatile administered. If the collapse be profound, a mustard plaster may be placed over the heart, the feet put in very hot water, or ether injected hypodermically.

When a bad burn has once been dressed, if shock be present, there should be no hurry to change the extemporised dressings for applications which may be in themselves more suitable, but the patient should if possible be left alone so far as dressing is concerned, until the state of collapse has passed off. In twenty-four hours, however, it will generally be necessary to re-dress the burn, and now (or in the first instance, if skilled assistance and proper materials have been procured) it must be done with the greatest care. If the burn be extensive, it is almost always best to perform the first two or three dressings under an anæsthetic, not only because the burnt surface is exquisitely tender,

but on aeeount of the nervous shoek of the exposure.

The fresh dressings should always be got ready before the burn is uncovered. The ones generally used for burns in their early stages are—(1.) "Carron" oil, *i.e.*, a mixture of oil and lime water in equal parts. (Linseed oil was originally employed, but olive oil is cleaner.) (2.) Carbolised oil. (3.) A saturated solution of common washing soda.

Any of these may be applied by means of soaked strips of lint; and layers of cotton wool should always be placed over the strips.

The soda solution generally gives the greatest relief to the pain, but the Carron Oil is also a very bland and soothing dressing. The objection to both is that the prevalent discharges very soon become foul, and for this reason we prefer, in most cases, the carbolised oil. As a rule the 1 in 40 strength is sufficient, but, fo very painful surfaces, the anæsthetic effect of 1 in 20 solution is sometimes very striking.*

Whatever may be in contact with the burn should not be *pulled*, but *washed* away with a stream of lukewarm Condy or carbolic lotion from a syringe, and the surface should be cleansed in the same way. It is often wise if the burn be extensive, to cleanse and dress one part of it, before uncovering the rest, and the fresh dressings should always be put on as quickly as may be consistent with cleanliness.

Small blisters may be snipped, and the serum soaked up with blotting paper, but in large ones the skin had better be cut away with sharp scissors.

A mode of dressing which is not commonly employed, but which has much to recommend it, particularly if the discharges be offensive, is to use the carbolic spray, as in Listerian dressings, and then over the carbolised oil lint, to place a covering of salicylic wool, or carbolised gauze.

* A 2 per cent. solution of Cocaine has been recently recommended with the object of lowering the sensibility of the burnt surface.

The following dressings are also useful in many cases:—

a. The lotion of chlorinated soda (P. B.), especially if there be fœtor.

b. A mixture of chalk, or whiting, olive oil, and vinegar, in about equal parts.

c. Whiting and water.

d. Olive oil and litharge (which form a kind of soap by chemical action).

e. A solution of about ℥ i of yellow soap to a pint of water, has sometimes a decided anodyne action.

Air may be strictly excluded from the burnt surface in two ways. Firstly, by continuous immersion of the injured part in a Condy or carbolic bath, and secondly, by sealing the surface with flexible collodion. This answers admirably for small burns, but for these only.

Granulations spring up over the surface of a burn with great rapidity, and as soon as this occurs the sore may be considered in the light of a healthy and healing ulcer, though one, it may be of large extent.

Skin grafting.

There can be no doubt that fragments of epidermis, or even epidermal scales from the horny layer only, when applied to, and retained upon, the surface of healthy granulations, do form little cicatricial foci, which may hasten the ultimate covering in of the sore, and diminish that drawing together of the edges which is so apt to occur in the healing. Whatever the process may essentially be, and it is very obscure, it is not a transplantation, or even a "grafting" proper, for the implanted tissue is non-vascular.

It is often difficult to estimate the real gain, even of successful grafting, but upon the whole it has hardly realised the promise it held out at the time of its introduction, for the islands of cicatricial tissue are very apt to disappear after they have been formed, and the quality of the cicatrix is often indifferent.

To obtain any success in skin grafting, the granulating surface must be typically healthy. Given

a good soil, it is only necessary to plant a number of pieces of detached epidermis, the smaller the better, upon it, and to fix them there without disturbance for not less than two days. The grafts should only include the horny and Malpighian layers of the epidermis, and may be snipped off with ordinary curved scissors, or with the special ones (Fig. 55), devised for that purpose.

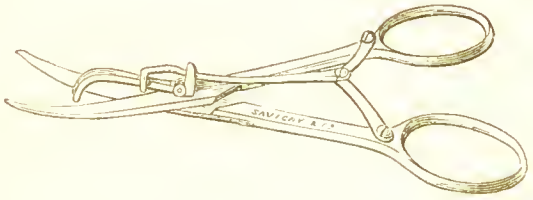


FIG. 55.—*Skin Grafting Scissors.*

The grafts should not be handled, but should be immediately placed, the dermal side downwards, upon the granulating surface, which must itself be cleansed and dried beforehand. The grafts should then be covered with small pieces of gold beater's skin, or gutta percha tissue, or isinglass plaster.

Inasmuch as the surface of the burn or ulcer when grafted must be left undisturbed for a couple of days, it is convenient to cover it up in salicylic wool, or boracic lint, which will hinder it becoming foul. A good number of grafts should be planted at one time, say, about one for every square inch of burnt surface, for the probability is that many will fail to take. A successful plant will be known when the part is uncovered, by the presence of a whitish pearly spot, which will increase from day to day, and will soon evidently be an island of cicatrised tissue. Other plans of grafting, such as the dusting of epithelial scrapings over the wound, have not held their ground.

II. *Burns, important through the depths of tissue destroyed.*

Those burns which destroy muscle, tendon, and bone, are either immediately fatal, as in most cases when the trunk is involved, or, if in the limbs, produce practically the same condition as that of gangrene.

As to the general management of such cases, nothing further need be said than that they require the same treatment in the first instance, as the milder kinds of burns, both for the shock, and the local injury.

But burns frequently are inflicted, of which the appearance at first sight is not different at all from that of the large superficial injuries we have been considering, and which indeed may be quite as large, and attended with as important a degree of shock. Nevertheless, in all the later stages of repair, this class of burns, those namely where *the whole thickness of the true skin has been destroyed*; follow a very different course from the superficial ones, and one harder to treat.

Not that these burns are slower to heal than the other ones, indeed if they are left alone, they will close over more quickly, by dragging the margins together towards the centre; but it is in this contraction of the edges, and in the fact that the process of shrinking does not cease even when the sore is closed over, that the especial difficulty of these cases consists, and the dresser will assuredly find himself on the horns of a dilemma, for either he must, by fixing the parts to prevent contraction, greatly retard their healing; or if he allow the edges of the burn to come together, anyhow they will, he will quite certainly be accessory to the development of deformity, while for his consolation he has only the knowledge, that let him try his best, the contraction will almost certainly beat him in the end.

In so far as the actual dressing of the injury is concerned, the similar applications to those mentioned for more superficial burns will be appropriate.

The contraction begins very insidiously, but becomes more and more marked and stubborn as the case goes on; as has been said, it does not cease with the covering over of the sore surface, but for months, or years, bands of contracting tissue will form in the ribbed and furrowed scar.

The effect of this contraction shows worst when the face, or neck, or the flexor aspect of any large joint is involved, and most surgical text books have representations, not at all exaggerated, of the deformity which may thus happen.

To combat this misfortune is very difficult, and the dresser may often wisely make up his mind to a certain amount of undeserved blame in any event. But much may and should be done by steadily and patiently splinting, or fixing the part in some way or other, and by willingly exchanging for a quick, a very slow healing. So, too, the effect of the patient, daily, application of the solid nitrate of silver, should not be forgotten. Something may perhaps be done too by skin grafting. But probably more effectual improvement can be attained after the burn has healed by stretching the cicatrix, than during the healing. Though it has been several times pointed out, it is still often forgotten that this contracting scar tissue is as distensile as it is contractile if it be properly manipulated, and that by patient handling a rigid tendinous band may be converted into a supple elastic one. The results of prolonged stretching, kneading and shampooing the scars of burns are as satisfactory as those of plastic operations for the same end are disappointing.

An anæsthetic is sometimes desirable upon the early occasions of kneading and stretching, and the progress of the extension should be slow and gradual. Care must also be taken not to tear through the superficial cicatrix and thus to cause a wound. A little oil may be used to rub into the scar during the manipulation. This way of treating a contracted cicatrix is too often neglected in favour of more tempting but far less satis-

factory plastic operations, and even if the latter be deemed necessary the preliminary kneading will have greatly improved the nutrition of the parts concerned.

Scalds or burns of the larynx and pharynx present such especial features that they must be mentioned separately.

They are produced generally by drinking scalding liquids, and are thus far more frequent in children than in more sensible adults. (The habit of teaching children to drink out of the spout of a kettle will account for more scalds of these parts than all other causes put together.) But breathing hot air, as in a fire, may produce the same effects, and practically the action of any chemical caustic is the same in this situation as that of the thermal ones.

Scalds of the pharynx itself are not usually very serious, unless the consequent œdema of the tongue and fauces reaches a very high degree; but when the scald extends further down, so as to affect the *rima glottidis*, and the œsophagus, there is both an immediate and remote risk of complications. The remote one is that the scald of the gullet may cause a contracting cicatrix, and thus become itself a simple stricture, or that the cicatrix may be the seat of a new growth, and thus develop into a malignant one.

But it is with the immediate risk of suffocation through œdema of the larynx that we have here to do. These cases are always full of anxiety, and must be most anxiously watched. If, shortly after the accident, there be a distinct difficulty of breathing, from obstruction, the surgeon will not wait for more urgent symptoms, but will at once perform laryngotomy, or in young children, a high tracheotomy. The case should then be treated with a warm moistened atmosphere, and in all other respects as if it were a case of diphtheria or croup in which the operation had been called for. But often there is a deceitful calm for some hours, and we may be tempted to think that the larynx has escaped altogether, when suddenly

the most urgent dyspnœa may be developed. Whenever, therefore, inspection of the mouth and throat shows that a scalding fluid, or a corrosive liquid has passed down it, the patient must be carefully watched, made to breathe a steamy atmosphere, and the surgeon should be ready himself, and have his instruments in readiness, to open the windpipe if necessary.

SECTION III.

OF THE TREATMENT, IN THE FIRST INSTANCE, OF ACCIDENTS AND EMERGENCIES.

Chapter VII.

OF THE IMMEDIATE TREATMENT OF FRACTURES, IMPROVISED SPLINTING, ETC.

The first time the student makes a post mortem examination on a recent case of fracture, however simple, even if there be to outward seeming only a very slight amount of injury, he cannot fail to be astonished at the extent to which the tissues have really suffered, at the amount of bruising and disorganisation of the muscles, and at the infiltration of all the softer parts with extravasated blood. And yet, provided that such a fracture be simple, or if compound, that septic forms of inflammation are successfully warded off, it is astonishing how quickly tissues, bruised and hurt as these are, will recover.

A further examination of a recent fracture on the post mortem table will shew that the injury of the soft parts has been, to a large extent, due to the working of the sharp, splintered fragments among the more yielding tissues; indeed, in fractures by indirect violence, this is the only cause of their injury.

In considering then, the general line of conduct in cases of fracture, the student should think of the condition of the limb inside the skin, and appreciate that

it is probably much worse than appears upon the surface ; and further, he should recollect that between the time of the occurrence of the fracture and its being set, careless or improper handling may do much mischief, so that it not infrequently happens that by movements on the part of the patient or of his friends, a simple fracture is converted into a compound one ; or, more rarely, an important vessel or nerve is seriously injured.

It will therefore be seen that there are many points for consideration in the treatment of a case of fracture, in addition to the actual, and so to speak, permanent setting of the bones.

So long as the patient can be left lying, little further harm can come to the broken bones, so that there need be no hurry.

The chief points in the immediate treatment of fractures are :—

1. The prevention of further injury (*a*) by means of some improvised support or splint, (*b*) by proper precautions in transport.

2. The arrangement of the bed on which the patient has to lie, probably for some weeks, the getting him into it, and the general management of affairs in the interval which must elapse before the setting.

I.—MEASURES FOR PREVENTION OF FURTHER INJURY.

Improvised Splinting.—This is desirable when there is any appreciable movement between the fragments, any painful spasm of the muscles, or whenever the patient has to be moved to any distance. The ways in which more or less efficient splints may be made are very numerous, so that in this matter the principles of the improvisation being indicated, the details must be left to the individual readiness and energy of the surgeon. Whatever comes first to hand will of course be used first, as firewood, match-boarding, cigar boxes, bookcovers, paper, etc., and it will hardly ever be

found difficult to give sufficient support to any fracture. Even a newspaper will be of great service, if it be folded often enough, especially if it be bent round so as to form a portion of the hollow cylinder. In fractures of the leg, too, the use which may be made of the opposite sound one as a splint, by tying the two limbs together, should always be remembered.



FIG. 56.—*Illustration of Improvised Splinting.*

This figure has been drawn to show a few of the ways in which common materials, such as firewood, towels, and handkerchiefs, may be used for the temporary support of fracture of the collar bone, humerus, and of the bones of the leg.

As a rule *removal of clothes* is unwise until the patient is about to be put into bed, when it can be done deliberately, and so as to cause as little pain as possible, but if the fracture be badly compound, or if

there be serious hæmorrhage, the clothing must be removed for the careful examination of the parts. These cases of hæmorrhage in connection with fracture are always serious, and the necessity of attending to this condition will take precedence of the question of supporting the broken bones.

Improvised splints should always be put on in a way which will allow of their ready removal, and in applying them there need be no effort made accurately to replace the fractured parts, but merely in a general and gentle fashion to reduce the deformity, and give support as far as this may easily be done.

The following directions will serve as examples of what may be done in some of the more common accidents involving fracture of bones, in the way of a rough and ready splinting, it being understood that they are *examples* only.

(1.) *Fractured lower jaw.* This will have occurred as a result of some direct violence, and there will be a good deal of bruising of the soft parts. All that will be required in the first instance will be to tie up the lower jaw against the upper one with a soft handkerchief, passed under the chin and over the vertex of the scull. The patient must not talk, and if any nourishment has to be taken it should be poured slowly into the mouth at one of the angles. If any long time must elapse between the accident and the permanent setting, a cardboard or gutta-percha splint may be made and fixed on with the *four-tailed bandage* (Fig. 29).

The moulded splint should be fashioned out of an oblong piece of gutta-percha or felt, about 10in. by 5 in. for an adult man (the size will, of course, vary), and must be cut down the middle of its length, except for about three inches in the centre, so that it is of the shape of the centre of the four-tailed bandage which has been before described. To mould and apply it, the four ends thus made must be folded up while it is warm, exactly as the bandage is. It will be wise to cut out a paper shape first to secure an exact fit. If it

be necessary, as for the dressing of a wound on the chin, a trap door may be cut in the splint.



FIG. 57. *Moulded Splint for Lower Jaw.*

(2.) *Broken collar-bone.* Practically this always happens by an indirect shock, as by falling on the shoulder, or on the out-stretched hand. The patient instinctively supports the elbow and forearm of the injured side with the other arm, and so pushes up the shoulder, which would otherwise droop. If the patient can be conveniently put to bed on a hard mattress, flat on the back, with a small pillow between the shoulders, and a very small one (or none at all) under the head, the fragments of the clavicle will come absolutely into apposition. But often when this accident happens the sufferer has to travel for some distance, and although by merely slinging the arm all risk of any great additional damage will be avoided, a better plan is to use a couple of towels or triangular bandages in the way now to be described. With these the arm can easily be fixed in a position which will give complete comfort, and indeed, in many cases will

bring the fragments into sufficiently good position to enable union to take place without any noticeable deformity. This method is also suitable for the permanent setting.

The indications to be fulfilled in cases of fractured clavicle are—that the shoulder must be well pushed up, the arm must be fastened to the side with the elbow behind a vertical line dropped from the point of the shoulder, and that the shoulder joint should be forced away from the thorax by a pad placed in the axilla, to counteract the tendency of the broken ends of the clavicle to overlap. A way in which this may readily be done is shown in Fig. 56 (and also in Fig. 58). A soft, but firm pad, of about the size of one's fist is made, as with a cricketing cap or a newspaper, and is placed in the axilla; the forearm is crossed over the chest, with the hand pointing to the opposite shoulder, the point of the elbow being held well back. A towel is then folded as a broad scarf, the elbow is settled into the middle of it, and then, by tying the ends over the opposite shoulder, the hand and forearm being covered by the scarf, the arm on the injured side can be pushed well up. The other towel is then brought round so as to fasten the arm, forearm, and hand, firmly to the trunk, and the ends are knotted or pinned beneath the opposite armpit. A reference to the figure will explain better than words can do, these simple but efficient arrangements.



FIG. 58.—*Treatment of Fractured Clavicle with two towels, or Triangular Bandages.*

(3.) *Fractures in the neighbourhood of the shoulder joint.* For this, inasmuch as the displacement and mobility of the fragments are both very slight, a well-adjusted sling is all that is required at first, or during removal.

(4.) *Fracture of the shaft of the humerus.* Here the displacement may be considerable, and the ends of the broken bone, by moving on each other, may cause much pain and muscular spasm. The weight of the forearm must be utilised to prevent overlapping of the fragments, and a little gentle traction may be made at the elbow. Some short pieces of firewood, cardboard, etc., should then be tied round the limb, outside the sleeve, with handkerchiefs, or something of the kind, care being taken that those on the inside are so short that the circulation is not impeded at the elbow. The hand and wrist should then be slung in a towel folded scarfwise.

(5.) *Fractures about the elbow joint.* The forearm should be slung, but it will be unwise to attempt any reduction of the fracture, which is usually complicated with dislocation, till arrangements have been made for its regular setting.

(6.) *Fracture of the bones of the forearm.* The limb should be supported by two splints, which need not be very rigid (brown paper folded several times will do very well), placed along the front and back of the hand and forearm, and reaching from the elbow to beyond the tips of the fingers. The hand should be placed midway between pronation and supination, with the thumb upwards; the splint on the flexor side must not embarass the brachial artery when the arm is bent. The splints may be tied on with handkerchiefs, and the arm supported with a broad sling.

(7.) *Colles' fracture at the wrist.* Impaction is almost always present in these cases, so there is no risk of undue mobility. A simple sling, therefore, is all that will generally be necessary, but sometimes, when there is painful spasm of the flexors of the fingers, relief is afforded by a soft splint along the

front of the hand and forearm, lightly tied on. The fracture should always be set as soon as possible.

(8.) *Fractured ribs.*—When an accident has happened, which in the nature of things may have caused one or more ribs to give way, and the injured person complains of a stabbing pain or "catch" in the breath, on inspiration, with other signs of embarrassment of the breathing movements, it will not be necessary in the first instance to distinguish whether there has been a bruising or an actual fracture of the thoracic walls. In the majority of cases it will be found that immediate relief is afforded by placing the hands on either side of the chest, and compressing the thoracic walls gently, but firmly. Very often the patient will have found this out, and may even have tied his scarf tightly round his body. Until a more complete support can be given to the thorax by strapping and bandaging, something in the way of a scarf or towel must be tied round the chest with the tightness which will give the greatest amount of relief.

A patient with broken ribs may thus be able to get home without much suffering, but he should be cautioned against any movement which would require any but the shallowest respiration, for though he may be comfortable enough so long as the diaphragm alone is concerned in the performance of breathing, his pain would be much aggravated by any effort which would bring the chest walls into play.

(9.) *Fractured Spine.* Whenever, or under whatever circumstances the back appears to be broken, no question of splinting can arise, but the harm, or rather the disaster, which may be wrought by rough or careless handling, cannot be too thoroughly realised.

The symptoms of fractured spine being present, the injured person should be placed in the supine, or prone position, the latter being generally preferable, on the ground, with the trunk as straight as it can be gently put. In the absence of a stretcher, a gate, hurdle, shutter, or some other rigid platform should be pro-

cured, and placed close to the patient, who must be placed on it with the least possible alteration of position.

(10.) *Fractured Pelvis.* This may occur from a fall, but in most cases the cause will be the passage of some crushing weight, as the wheels of a wagon. Little requires to be done in the first instance; but relief may be given by tying a broad scarf or belt round the pelvis, and the patient must be quickly placed on a stretcher or its substitute. It sometimes happens that even after a most severe injury to the pelvis, the patient is able to walk after a fashion, but this must never be allowed when there is evidence that a weight sufficient to fracture the pelvic girdle has passed over the body.

(11.) *Fracture of the neck of the Thigh-bone:*— 1. *Fracture in old people.* This will only require that the patient be moved with gentleness; no other precautions are necessary. 2. *Fracture with violence*, and injury to the softer parts around. This will usually be extra-capsular, and generally occurs in adults. In any case precautions must be taken to prevent further damage in removal; these, however, will be practically the same as are required in the following case.

(12.) *Fracture of the shaft of the Femur.* In consequence of the length and strength of this bone, its fracture may be attended with great disorganisation of the surrounding parts, and the injury is very easily made more serious still by rough or unskilful handling. In these cases the principal difficulty is that of transport, and the reader has only to imagine what might be the consequences of ill-advised efforts to move a heavy man with his thigh broken in the middle and unsupported, to see at once that no attempt should be made to move an adult thus injured till the limb has been rendered fairly stiff by improvised splinting. The end desired is practically to make the patient's body rigid from the armpit to the ankle, so as to prevent all risk of a bending or buckling up of the broken

ends of the bone, which would otherwise readily occur. The patient should be kept lying absolutely flat on the back, and search should be made for something long and strong enough to serve as a "girder" to run the whole length of the body (a rifle or a broomstick will do admirably). This must then be laid along the injured side, the top going beneath the axilla, and the limb should be very gently straightened, since by this time it will probably have become much abducted, and rotated outwards. Then with numerous handkerchiefs, towels, etc., this long splint must be fastened on, passing the bandages round the thorax and pelvis. Along the inner side of the leg, a short splint, say an umbrella, should then be placed, and a back splint of thin board, or stiff paper folded, may be placed along the back of the thigh. These supports must then be fastened round the thigh, leg, and foot, as can best be managed. Finally, the injured limb must be tied to the sound one in two or three places.

If these proceedings have been thoroughly carried out, it should be possible, although it would be unwise, to carry the patient simply by the head and heels, without any bending.

(13.) *Fracture near the knee joint.* Here the risk of injury is very much less, and one of two plans may be adopted. If the limb be lying fairly straight, an inside and an outside splint, as two walking sticks, should be tied on with several handkerchiefs, avoiding the actual seat of fracture; or what will be found more comfortable, especially if the limb be bent, will be to place beneath the joint a thick pillow or other support, keeping it in the flexed position with a few bandages tied round all.

(14.) *In a fractured Patella*, the great indication is to avoid increased separation of the fragments and further damage to the knee joint beneath. This will best be done by a strong back splint of umbrellas, boarding, etc., running the whole length of the thigh and leg, and tied on firmly with handkerchiefs.

(15.) *Fractures of one or both bones of the leg*

generally occur from direct violence, and because the skin is so thin over the shin bone they are very apt to become secondarily compound, and may be so from the beginning. These fractures are thus often extremely severe injuries, and require much care and gentleness in handling. If the limb be very much crushed, with comminution of the bones, whether the fracture be compound or not, probably the best plan will be to take a soft pillow and arrange the stuffing so as to form a trough, lay the limb in it, and tie it up with soft bandages. In slighter cases, splints long enough to reach below the feet must be put on both the outer and inner sides, or on the outer one only. (See Fig. 56.) If the boot can be easily taken off, as by cutting up the side springs or laces, this should be done, but it should be left alone if it seems that removal could cause the slightest damage.

(16.) *In Pott's fracture with dislocation at the ankle joint*, it will be unwise to use any force to rectify the deformity, which will often be considerable. The boot should be cut off, and a splint, extending from the knee to below the foot, should be put on the inner or the outer side, as seems best, with handkerchiefs. The foot should be placed in as nearly a natural position as it will readily come to.

Finally, in those cases of *compound dislocation of the ankle*, or of a *general crush* of the parts about the foot, caused by great violence, little can be done, except to tie the parts up in a pillow, or to use such other materials for soft support as the circumstances of the case will admit of.

Method of transport of cases of fracture, and precautions to be taken therein :—

In military surgery it naturally happens that great stress is laid upon the best ways of moving people, helpless from injury, whether through fracture or otherwise. A regular stretcher drill is laid down, and other plans for lifting and carrying are carefully considered.

But in civil practice, and in connection with the

proper work of house surgeons and dressers, elaborate descriptions of the different kinds of stretchers and of kindred details would be out of place; still, it is desirable that all civilian dressers, surgeons, nurses, or porters, who have to do with helpless people, should have some acquaintance with the best ways of lifting and moving them, and one or two of these ways will here be mentioned, supposing always that the injured person is unable to walk at all. (The case of children need not here occupy our time.)

If two people only, A and B, are available for the transport, and the person is able to sit up a little, the best way to manage will be for them to make a "sedan chair" by crossing their arms. Of this "chair" there are three patterns, but one only is figured here, because it is the best for general use.

In the first of the two other plans, the fingers of the right hand of A, and the left hand of B are interlocked to form a seat, while A's left hand is placed on B's shoulder, and *vice versa*, to make a back support.

In the second plan both A's and one of B's hands are joined to form a triangular seat, and B's other hand rests on A's shoulder, forming a chair back.

But the third way figured here (Fig. 59) is the best.



Fig. 59.—*Hands forming Sedan Chair.*

where both pair of hands are used, locked together to form a seat, and where the patient supports himself by his hands placed upon the bearers' shoulders.

If the patient be quite helpless or senseless, whether he has to be carried any distance, or has only to be lifted on to a stretcher or bed, the assistance of three people is desirable, two, A and B to do the lifting, and the third, C, to look after the injured limb and the patient generally.

A and B take up a position on the opposite sides of the patient, near his haunch bones, facing each other; they then stoop down, and each gradually gets one hand under his back, near the shoulder blades, till they meet and are clasped; the other hands are then passed and locked under the breach.

Having secured a firm grasp they rise together from the stooping posture with the patient, and are ready to move. It is not advisable for either to kneel, unless they cannot stoop low enough, but if one does both must.

A patient lifted in this way can readily be placed on a bed, or be lowered on to a stretcher for more convenient carriage. In lifting a stretcher the taller of the bearers should go to the head, and should give the directions as to the time of lifting, etc. The head should always be lifted a little before, and lowered a little after the feet. In carrying anyone on a stretcher, the bearers should not keep step, but the left foot of the one must be put forward with the right of the other, to avoid swaying.

With regard to conveyance in cabs, a four-wheeler is much better than a hansom. If the injury be very severe the patient should be lying down if possible, either from seat to seat, or if that space is insufficient, a stretcher may be laid across the floor of the cab, both doors being opened.

When a patient has been brought to the bedside, it will generally be found convenient to remove the boots and outer clothing as he lies on the stretcher, and then to lift him on to the bed as described above, when

the removal of the clothes may be completed at leisure.

II.—OF FRACTURE BEDS.

There are certain points to be looked to with regard to the bed on which a patient with a fractured limb will have to lie, and inasmuch as it is probable that once there, any further movement will be hurtful, they should be considered and met *before* the patient is placed on it.

The essential qualities which the bed should possess are, that there should nowhere be any "sagging," or possibility of giving way, that the surface should be evenly smooth and comfortably elastic, and that the foot of the mattress should be somewhat higher than the head.

In practice it will be found that very few bedsteads fulfil these requirements; even the best (the wire-woven beds, or those with interlaced iron bands), will allow of a certain giving way where the greatest weight of the body comes, while this occurs to a much greater extent in sacking, or sofa spring beds. The evils of this yielding and formation of a hollow under the patient are not so apparent at first as they afterwards become; the patient gradually slips down, the head and shoulders are pushed forward, and the heels come up, until, instead of lying in a straight line, the body forms two sides of a triangle, the apex of which is at the ischial tuberosities, to the grievous alteration of the parts about the seat of fracture, and to the great risk of the formation of bed sores.

Fortunately the remedy is easy, and involves no apparatus, all that is required being a light wooden frame or a few light boards placed on the bedstead, underneath the mattress. If the mattresses are of the kind to be described directly, no discomfort will be felt after a very little time from the rigidity of these boards, even by those who are accustomed to lie softly.

while they are quite as efficient as any special bedsteads that have ever been devised.

A big bed is a big misfortune in all cases of sickness, but especially in fractures. The best size is that of the ordinary single bed, as found in hospitals and elsewhere, namely, 6 ft. 6 in. by 3 ft. or 3 ft. 6 in.

It is a matter of great importance that the *mattresses* in fracture cases should possess the qualities of smoothness and elasticity in perfection, and for this reason any form of "bed," either of feathers or any other material, is quite inadmissible. Flock mattresses are objectionable, as, even if they are well made, they tend in time to form knots or lumps. The best combination of all is a straw palliasse, and over that, one or two horse-hair mattresses, 3½in. to 4in. thick. Over the mattress one blanket is generally found useful. The sheets, etc., require no particular directions, save that if a draw-sheet and macintosh are required, they should be arranged before the patient is put to bed.

In cases of fracture of the lower extremities, or of the spine, *all* pillows, bolsters, etc., are harmful, except the merest cushion beneath the head, at any rate in the early stages of union; and if the patient can be induced to lie thus flat, the position will not produce discomfort after the first day or two. Any pillows should be small and firm, and covered with separate slips.

The bed being ready, the patient, if completely disabled, should be very gently lifted on to it; the clothing should be removed, cutting off the boots and ripping up the seams of the clothes, if this has not been done before, the sound arm or leg being the one which should first be slipped out of the sleeve or trouser. As a rule, everything in the shape of temporary splints may now be taken off and the limb should be placed in the most natural position in which it will easily lie, on a pillow fashioned into a kind of trough. Sandbags are very often useful in restraining spasmodic movements or in steadying the limb. All pressure of the bedclothes must be taken off by a

regular eradle, or one improvised out of some such thing as a bandbox split open. Lint dipped in some evaporating lotion may then be applied to the surface of the fractured limb. If the case be a severe one, especially if there be much spasm, a hypodermic injection of morphia will now be found extremely useful.

Chapter VIII.

Of the Immediate Arrest of Hæmorrhage.

There are few accidents which test the qualities of courage, readiness, and energy, more than the occurrence of a violent hæmorrhage; and in such a case the prompt adoption of common-sense measures will be found to be of far greater service than any routine of book-learnt rules.

In the first place it must always be borne in mind that blood, like water, will not run up hill except upon compulsion. The effects of *Position* and of an unhindered return of blood to the heart, are thus very important. Yet how often may we see a man with severe epistaxis stooping over a basin, his neck the while encircled by a tight collar; or a bleeding varicose ulcer, with a garter grasping the saphena vein!

Sheer neglect of the most elementary of nature's laws is the cause of mistakes such as these.

Again we must not forget that, as has been well said, "There is no bleeding from the exterior of the body which cannot be temporarily arrested by firm pressure with the fingers." It matters not for the moment whether the bleeding be arterial, or venous, or capillary; the thing required is to stop it, and pressure will always do this. Too much stress should not be laid upon the kind of vessels involved in the bleeding. A distended vein may bleed as furiously as an artery; so may a mass of capillaries in inflamed tissues. But in all, the first means of arrest must be pressure.

Pressure, *position*, and the *removal of all hindrances* to the free return of blood to the right heart, are the cardinal points in the initial arrest of all forms of hæmorrhage.

It may not be out of place here briefly to remind

the reader of the series of processes included under the name of natural arrest of hæmorrhage.

The process in the case of *capillary hæmorrhage* is usually simple and quick enough. The capillary vessels proper contract, and the blood coagulates over the surface of the wound, while underneath the surface of this coat of clot there is poured out a layer of highly coagulable lymph, which seals up the ends of the vessels, and is the first step towards the repair of the injury.

In the veins the chief agent in natural arrest is the contraction of the venous walls, combined with coagulation of the blood. This contraction occurs at the cut ends only, and does so more rapidly in the case of arteries, so that one may often see the veins on the face of an amputation stump distended with blood but with their ends completely closed, so that they take the shape of nipple-like projections.

Veins do not appear to retract so perfectly within their sheaths as arteries do; while with regard to the later stages of the process of natural arrest, such as the formation of external and internal coagula, etc., all that need be said here is that in its general outlines the process is similar to what happens in the case of arteries, but that it is somewhat less perfect.

In the natural arrest of *arterial hæmorrhage*, it is convenient to recognise two stages, which may be termed those of primary and permanent arrest.

The process of primary arrest in the case of small arteries consists (*a*) in the coagulation of the blood effused around the vessel, over its mouth, and between its sheath and its proper wall, (*b*) in the gradual contraction of the mouth of the vessel, and the formation of a coagulum in the lumen of the tube, (*c*) in the retraction of the vessel within its sheath.

If the vessel divided be a large one, or if from any cause the bleeding has been copious, there is added another factor in the arrest, namely, *syncope*, which within certain limits, is often a most fortunate occurrence for the patient, for the lowered action of the heart ceasing to pump the blood into the vessels, gives

time for clots to form, and for contraction and retraction to go on.

The process of permanent arrest is a gradual one, and often takes weeks to complete. It consists (*a*) in a continued retraction of the vessel within its sheath, (*b*) of a general shrinking up of the vessel itself and the parts in the neighbourhood, (*c*) of a disappearance of the clots and effused lymph, partly by absorption, partly by fibrous changes, and (*d*) of an organisation of the internal coagulum. Finally all that is left of the divided vessel up to the nearest offshoot, is a fibrous cord which itself may in the course of years, disappear.

Although in the face of an urgent necessity it is useless to carefully ascertain the precise character of the bleeding, still for the purposes of convenient description, it will be well to shortly consider the arrest of the three varieties—arterial, venous, and capillary—separately, bearing in mind that they are usually associated in any injury.

Capillary bleeding.—Probably this term is principally applied to bleeding from arterioles and venules, for it may well be doubted if the capillaries bleed much themselves when divided. However this may be, section or abrasion of any tissue, with a few exceptions, such as cartilage, tendon, etc., is always followed by an oozing of blood, which usually stops in a few moments "by itself." In any case, the slightest possible pressure, or simple exposure to the air, combined with attention to position, will be found amply sufficient to check ordinary capillary oozing.

Venous bleeding.—In some books, especially in those which are written to gratify the taste of the outside public for amateur or domestic surgery, we may still read that venous bleeding occurs only from the distal end of the cut vessel, and therefore the proper thing to do in the case of a cut vein, is to put a pad somewhere below the wound, but for ordinary venous bleeding, the first thing necessary is to see that there is nothing hindering the return of blood to the heart :

the second, to remember that almost all venous bleeding will cease on raising the limb; and the third, to remember that pressure will always effectually stop the flow of blood, if it be applied to the wound itself.

Arterial bleeding.—Attention to position and pressure will here be even more necessary than in the other forms, but pressure to be of use must be effectual. Only harm can come of tying up a wound in a half-hearted way, laying on covering after covering, rather with the idea of hiding the danger, than mastering it. On the other hand, a furious rush of blood, such as may come from a wounded carotid, or a ruptured aneurism, may be for a time controlled by a firm and judicious plugging of the wound, followed by pressure over it.

The general points to be fulfilled in plugging and applying pressure to a bleeding wound are simple enough. Whatever be the material employed, the whole wound must be *filled* with it, so that every part of the bleeding surfaces is pressed upon firmly enough to compress the cut ends of all the vessels exposed.

The best materials for plugging are (1) sponge in small pieces, quite dry, and compressed until they are hard: (2) strips of lint not more than three-quarters of an inch wide; (3) cotton wool. Of these, the first —sponge, is by far the most effective, although it is not so easy to apply. The best way is to take quite small pieces, and after drying them as far as possible, to pack them into the wound with a short director, until they are firmly compressed by its sides; in deep wounds it is sometimes advisable to tie a length of twine to the sponge, so as to be able to recover it.

In a similar fashion must the narrow strips of lint be packed into the wound, very gradually but firmly, care being taken that the deeper parts of the wound are plugged as well as the more superficial ones.

If cotton wool be used, and of the three it is the least satisfactory, it will generally be found best to soak it first in water, so as to express the air from its interstices, but in any case, as with the two preceding

materials, the packing must be done bit by bit, and very firmly.

The wound when plugged, usually requires a firm compress over all. This may be conveniently made of several layers of lint, cut to the required shape, and secured by a roller bandage; or by a triangular or scarf bandage arranged so that the knot comes over the pad.

It is often necessary to make a compress which shall be much thicker in the middle than at the edges. This is effected by what is known as the "graduated compress," a series of pads of similar form, but diminishing in size, placed one on top of the other until a more or less flat-topped pyramid of lint is made.

The principal use for this sort of compress is for wounds in such situations as the palm of the hand, the axilla, etc., where it is often very difficult to secure efficient direct pressure.

It must not be supposed that all, or even most wounds require to be plugged. A pad and bandage firmly applied will be sufficient to check most hæmorrhages, and it must be remembered that plugging destroys all chance of healing without suppuration.

How long should plugs or pads be allowed to remain undisturbed? The time will, of course, vary, and in cases where the bleeding has been difficult of arrest, or has recurred more than once, no surgeon will be sorry to leave things alone as long as he can. On the other hand, he will constantly have in his mind's eye a picture of a wound getting more and more foul every hour, with no outlet for the discharges which are now forming, and with its edges possibly beginning to slough in consequence of the pressure put upon them.

For these reasons, twenty-four hours are generally as long as it is desirable to maintain pressure, and it will rarely happen that the removal of plugs at that interval will be followed by bleeding. Even if this does happen, re-plugging with fresh material will have diminished the risks of blood poisoning.

All materials used for the purposes of plugs or pads

must be absolutely clean, and should in all cases where time will allow of it, be impregnated with some antiseptic; thus sponges should be wrung out of a strong carbolic acid solution (1 in 20 to 1 in 40), and strips, or pads, of lint may be saturated with 1 in 20 carbolized oil. In spite of all, however, it will be found almost impossible to keep a plugged wound free from smell for any length of time.

Enough has already been said as to the importance of raising the parts from which hæmorrhage is taking place, and of the necessity of securing the free return of blood to the heart by the veins. These points are frequently neglected in the case of wounds of the extremities, and in bleeding of all kinds the effect which position exercises on the heart's action should be borne in mind, and acted upon.

The good effect of absolute quiet and the recumbent posture is most strikingly seen in internal hæmorrhages, but it is of importance in all, and should in all serious cases be attended to.

In flexion, too, of certain of the joints, we have a most valuable means of stopping arterial bleeding.

The positions of the brachial artery at the elbow, of the popliteal behind the knee, and of the femoral at Poupart's ligament, are such, that forcible flexion of elbow, knee, or hip joints, combined with placing a firm pad in the hollow of the joint, will, in many cases, completely stop the blood supply to the limb. The flexion must be forcible, and may be maintained by fixing the limb with a bandage.

OF SOME SPECIAL MEANS FOR THE ARREST OF HÆMORRHAGE.

(1.) By Digital compression.

The procedure which of all others is the simplest, in most cases the most efficient, and the readiest in cases of severe arterial bleeding, is the compression of the trunk vessel with the finger above the seat of the injury,

against some neighbouring bone. It is of course only applicable in cases of hæmorrhage in certain places, such as in the limbs, the neck, and some parts of the head and face. Moreover, unless relays of capable assistants can be procured, it cannot, in consequence of the fatigue it produces, be continued for more than ten minutes or a quarter of an hour. Long before that time however help may have arrived, or some improvised tourniquet (*vide infra*) may be applied.

The great value of digital compression lies in the fact that it can be applied at once, when those moments on which a life may hang will have been seized and saved.



FIG. 60.—*Position of Hands Compressing an Artery.*

With regard to the digital compression itself, practice alone will enable the student with absolute confidence to place his finger on the spot beneath which the artery is beating, but as to the manner in which it should be done, there are one or two points to recollect.

We should endeavour as far as possible to compress the vessel only. Great pain is caused by bruising large nerve trunks against the bone. And again, if in compressing the artery we at the same time compress the large venous trunks, or with the hands partially strangle the limb, the venous congestion, and therefore the general bleeding, is increased.

In compressing we should get the artery fairly against the bone, and press directly upon it. In this way a very moderate amount of pressure will suffice, and the pressure should be always as little as possible.

The position of the hand and finger to be employed will vary, but as a rule the thumb had better be used to make the pressure (Fig. 60), and reinforced if necessary by that of the other hand. The limb must always be raised.

The position and compression of particular arteries.

The following directions for the digital compression of particular arteries will serve also for their compression by the various forms of tourniquets, improvised, or of the regulation patterns. The accompanying diagram gives the position of the vessels in the situations where they may be compressed against adjacent bones. (*See* Fig. 61.)

The arteries of the head and neck.

In cases of injury to the scalp, the underlying skull affords an admirable resisting surface for compression, but the compression of a main trunk (such as the temporal or occipital on the head), at a distance from the wound, is not often effectual, in consequence of the extremely free anastomosis existing all over the surface. Nevertheless, in some cases, compression of the trunk of one of these vessels may be useful. In such a case they are readily found, and a very slight pressure against the bone with the fingers will suffice.

The *occipital artery* on the scalp at first lies behind the mastoid process, and higher up may be felt pulsating, and may be compressed half an inch behind and on a level with its base.

The *temporal* artery splits up into its main divisions soon after it passes over the zygoma, and should, therefore, be compressed against that process of bone, immediately in front of the tragus of the external ear.

Some of its branches may also be felt, and may be compressed higher up on the frontal bone.

The arteries of the face, like those of the head, anastomose so freely that the compression of their trunks only arrests incompletely the circulation in their branches.

It is, however, frequently necessary to compress either the facial trunk, or its coronary branches, as they encircle the mouth.

The trunk of the *facial* artery may be easily found, an inch in front of the angle of the jaw, and may be compressed there.

The *coronary* arteries form an exception to the rule of making digital compression against bone, for they are best compressed between the fingers introduced into the mouth, and the thumb on the face. They run round the mouth close beneath the mucous membrane, and about the third of an inch from the border of the lips. Their compression is often required in cases of operations, or cuts about the lips, and may then be effected between the blades of a pair of dressing forceps or by the use of special "harelip" forceps, of which there are one or two patterns (Fig. 62-63).

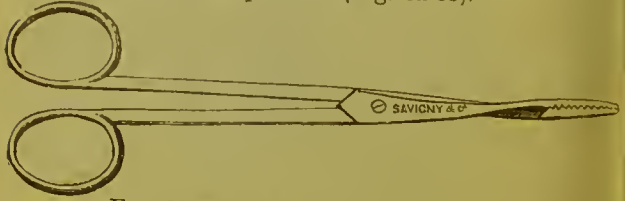


FIG. 62.—*Ordinary Dressing Forceps.*



FIG. 61.—*Diagram shewing the position of the Principal Arteries.* See page 109.

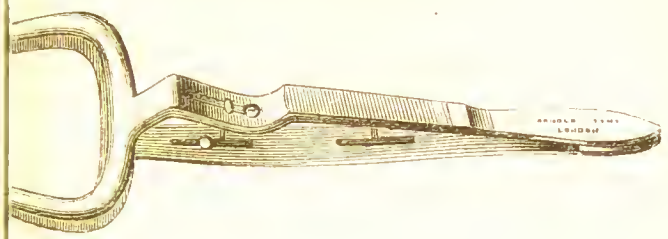


FIG. 63.—*Harelip Forceps.*

In the centre of the neck the only artery which ever has to be compressed is the *common carotid*, and the operation requires considerable care, in consequence of the proximity of structures which may not themselves be safely pressed on, such as the vagus nerve, jugular vein, trachea, etc.

The thumb should be placed over the artery at the level of the lower-edge of the thyroid cartilage; it will then be at the inner margin of the sterno-mastoid; pressure should then be made *inwards* and backwards. In this way the artery is forced away from the vein and nerve, and is compressed against the transverse processes of the cervical vertebræ.

The *third portion of the subclavian* is the only one which it is possible satisfactorily to compress, and it is here sometimes very difficult, sometimes very easy to occlude.

The bone against which it is to be pressed is the upper surface of the first rib, immediately outside the tubercle for the insertion of the scalenus anticus. In children or thin people, pressure behind the clavicle downwards and *backwards*, at the inner margin of the subclavian triangle will control the circulation, no matter what the position of the limb and neck may be, but in even moderately fat people it will be necessary to depress the clavicle and shoulder, to bring the artery near enough to the surface. This is usually easy enough to do, but it occasionally happens in the course of operations about the axilla or shoulder, that the

limb is required by the surgeon to be raised, while the assistant in charge of the vessel would prefer that it should be kept depressed. Especially does this happen in amputation at the shoulder joint, where, just at the moment when efficient pressure is most required (*i.e.*, just after the limb has been removed) the clavicle, freed from the downward drag of the arm, rises in the neck in a very exasperating fashion.

Various devices, such as the handle of a door key (Fig. 64), properly padded, a surgical "key" of a somewhat similar form, etc., have been devised to meet the difficulty, and it is sometimes advisable to divide the skin, platysma, and fascia over the triangle, so that the finger may be placed effectually on the artery. This may be readily done by dragging the skin downwards, and dividing it on the clavicle, as in the first stage of the operation for ligature of the subclavian.

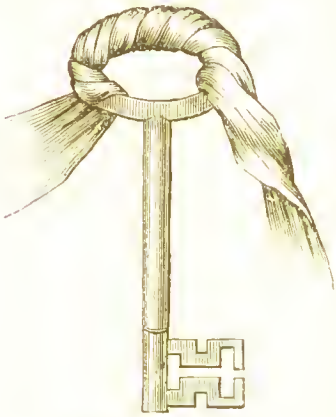


FIG. 64. *Handle of Door Key, padded.*

This proceeding is sometimes, no doubt, absolutely necessary, but with regard to the use of the key, etc., nothing in the author's experience is so effective as a compressor as the finger, if it be put in the right place. The mistake which is generally made is either making the pressure far too much outwards, near the acromion, or else not sufficiently backwards as well as downwards.

The first portion of the *axillary* artery can hardly be reached for compression. The lower half of the second, and the third parts, however, are tolerably superficial,

and can be compressed in the armpit, if that region be exposed by raising the arm. The pressure is made against the humerus in the same manner as in the following instance, and the vessel can be localised quite easily as it crosses to the outer side of the axillary space, and then lies amidst the trunks of the brachial plexus, with the coraco-brachialis to its outer side.

Brachial Artery. This artery probably more frequently requires compression than all the others put together, by reason of the great number of accidents to which the upper limb is liable.

It may practically be said to be sub-cutaneous in its whole length (Fig. 61), and may be compressed very readily against the humerus. The inner edge of the biceps which overlaps it in the middle third, is the guiding line for the vessel.



Fig. 65.—*Digital compression of Brachial Artery.*

At the bend of the elbow the artery may be compressed by the fingers, but not easily, and therefore arrest of hæmorrhage by flexion is preferable.

In the forearm also, except at the wrist, the circulation in the *radial* and *ulnar* arteries can hardly be controlled by any means, short of strangulation. At the wrist, however, both arteries become superficial, the radial somewhat more than the ulnar. The former lies between the tendons of the flexor carpi radialis and the supinator longus,

the latter between the radial border of the flexor carpi ulnaris and the flexor sublimis, and here they may be readily compressed. The digital compression of the palmar arches is practically inconvenient, and the pressure is usually made in other ways. (See bleeding from wounds of palm.)

The digital compression of the *abdominal aorta* is in some cases not so extremely difficult as is often supposed. It can generally be effected in children unless they are very fat, and in adults if they are thin, have lax abdominal walls, and a bold anterior lumbar vertebral curve.

The spot where this compression should be made is shown in the diagram as a point three quarters of an inch above a line drawn across the abdomen from one iliac spine to the other (the level of the aortic division into the two iliacs), and a little to the left of the middle line. But before pressure is made, the exact position of the artery should be ascertained, for it frequently is in the middle, or may even deviate somewhat to the right.

The digital compression is best and most readily made by the middle and forefinger of one hand, beneath which a small pad of lint should be placed, reinforced by the pressure of the fingers of the other hand. Pressure on the inferior cava trunk must be avoided as much as possible.

The umbilicus is sometimes given as a landmark for the vessel, but investigation has shown that its place is so variable, that it should not be taken as a trustworthy guide.

In many cases a moderately small hand well oiled can be introduced into the rectum, and pressure may be made upon either the *common or internal iliac* arteries by the fingers.

This procedure is not however at this time a common one. In the first place the introduction of the hand has to be performed under an anæsthetic, and very gradually, so that it is of little use upon an emergency: and secondly, the general belief is that the operation

is one attended by considerable risk of damage to the gut and its coverings.

Possibly however this mode of compression might be found useful in some rare cases of primary or secondary hæmorrhage from the sciatic or gluteal vessels, in a diffuse gluteal aneurism, or some analogous hæmorrhage, but no dresser should attempt the operation of the introduction of the whole hand into the rectum on his own responsibility.

Compression of the *common femoral* artery as it lies over the arch of the pubes is frequently required. In this situation the circulation may be completely controlled by making pressure directly downwards, *i.e.*, at right angles to the surface, midway between the pubic symphysis and iliac spine.

Care must be taken to avoid pressure on the vein as far as possible; this is best done by putting a small pad of lint underneath the finger. Frequently, however the vein is so far behind the artery, even when they come through into the thigh, that it cannot escape the pressure.

The inguinal glands too, as they lie parallel with Poupart's ligament, must be avoided, and if they are enlarged, this is sometimes very difficult.

The line of the *superficial femoral* artery is one taken from the point above mentioned between the symphysis and spine, and the inner side of the internal condyle of the femur.

When the knee is slightly flexed, and the thigh rotated outwards, firm pressure all along this line will generally succeed in stopping the current of blood, but as the artery gets deeper in its course, more and more force will be required; the artery, also, cannot be pressed directly against the bone.

As in the case of the brachial artery at the bend of the elbow, so with the popliteal, digital compression is very inefficient, while the circulation may be readily stopped by flexion. If a firm pad, about the size of a hen's egg, be placed in the hollow of the knee, and the knee be then bent up on it, the circulation will be quite stopped.

By any means short of complete strangulation of the limb, it will not be found possible, as a rule, to compress either the *anterior or posterior tibial* vessels in the legs, but the posterior one becomes quite superficial as it lies a little internal to the middle of the hollow between the heel and the inner ankle, going with the nerve beneath the annular ligament, between the common flexor of the toes, and the special flexor of the great toe.

The dorsal artery of the foot, the continuation of the anterior tibial may be felt and compressed against the astragalus, scaphoid and cuneiform bones, between the extensors of the big toe and of the other toes.

(2.) By strangulation of the limb.

The process generally known by the name of Esmarch's bloodless method consists in first of all emptying the limb of its blood by rolling a long india-rubber bandage, from below upwards to the spot where the circulation is wished to be controlled. At this spot a stout indiarubber tube two feet long with a hook at either end is passed round the limb, sufficiently tight to strangulate all the vessels, and the ends of the tube are then hooked into each other. (Fig. 66.)

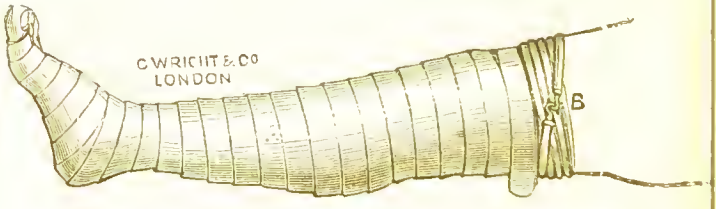


FIG. 66.—*Esmarch's Bandage and Tube applied.*

The indiarubber bandage is then removed, and the limb, thus rendered bloodless, will remain so until the tube is taken off.

This method is simple enough, and with ordinary care all chance of bleeding is prevented. It is especially useful in such operations as the removal of

sequestra, scraping or gouging carious bone, etc., where it is important to have the exposed parts as dry and bloodless as possible ; but it will also serve in the place of a tourniquet in amputations, or in other cases where it can be applied at some little distance from the seat of operation.

The strangulation by this method is so complete, veins, arteries, and capillaries being all compressed, that it is not safe to allow the tube to remain on long.

Its use therefore is not fitted for the restraint of accidental hæmorrhage, except as a temporary measure, and indeed in some very prolonged operation it is wise to remove the tube before the operation is finished.

When the Esmarch's bandage has been used in an operation, and only general oozing is expected to occur in the wound, it is generally convenient to apply the dressings, using such pressure as may be required, *before* the tube is taken off, for the absolutely bloodless condition of the small vessels has caused a temporary loss of tone in their walls, so that when the blood current is allowed to flow into them again, they for a time are much dilated, the whole limb becomes injected, and unless the wound has already been bandaged up, and pressure applied, there may be a very brisk flow of blood, and a corresponding delay in the dressing.

This rule will of course not apply if there be any vessels divided in the wound, big enough to require ligature or torsion.

There has been latterly an increasing desire to simplify Professor Esmarch's procedure, and to do away with the indiarubber bandage, while retaining the tube. It is found that if the limb be raised and the larger veins emptied of blood by the passage of the hand along the limb towards the trunk, that the former may be rendered nearly bloodless, and that the application of the tube alone is able to keep it so. It is felt too that where there are products of inflammation, especially if these are of a septic kind, it is at least hazardous to force them by the pressure of an

elastic roller bandage, from their place of origin into other parts.

The tubes used for encircling the limb should always be tested before they are used, for they are very liable to crack or break unexpectedly, especially at the ends, where the hooks are fastened.

In cases of operation about the shoulder, the hip, or the gluteal region, the tube may very usefully be put on in the form of a figure of 8, and in this way even such operations as amputations at the shoulder or hip joints have been rendered almost bloodless. The plan succeeds best where there is much emaciation.

(3.) By Tourniquets.

A tourniquet is, properly speaking, an apparatus for screwing down a pad upon a vessel. Practically, however, the term is applied to any means by which pressure may be put upon a vessel and mechanically maintained.

The principal forms, which alone will be described, may be roughly separated into three classes—improvised, screw, and indiarubber, or elastic, tourniquets.

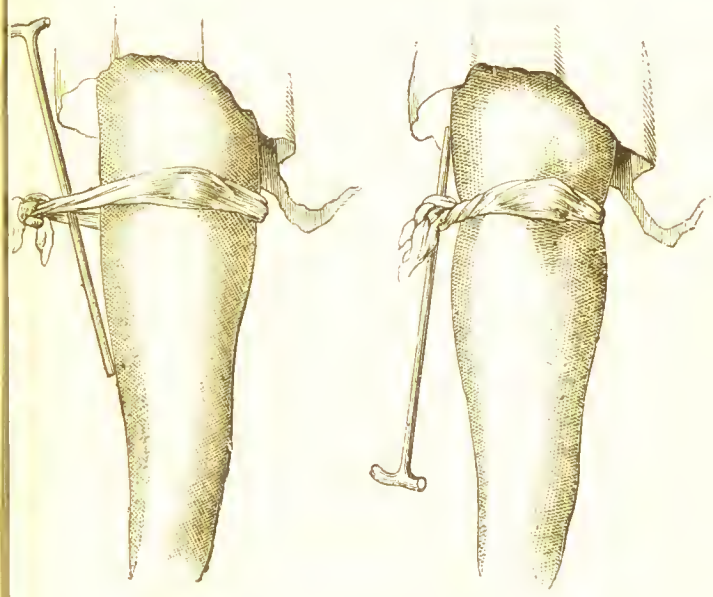
The improvised tourniquet is an efficient and ready improvement on the time-honoured method of stopping bleeding from any part by tying something round it, somewhere between the wound and the heart, tightly enough to strangulate all the tissues.

In the improvised tourniquet especial pressure is put upon the main artery, and therefore the force required is very much less, and the venous return is at least not wholly obstructed.

Its manufacture and application are simple enough. A handkerchief is taken, folded up like a cravat, and a piece of cork or wood, or a pebble, is inserted between the folds, so as to act as a pad. This pad is placed over the artery, and the cravat *loosely* knotted round the limb, the knot coming on its outer side. (Figs. 67 and 68.) An umbrella or ruler, or any moderately strong rod or stick is then passed between the limb and the knot and twisted round. The leverage thus

obtained is very great, and it is far more easy to err on the side of too much compression than of too little.

This form of tourniquet is known also by the names of "The Garrot" or the "Spanish Windlass."



FIGS. 67 and 68.—*The Improvised Tourniquet or "Garrot."*

Of screw tourniquets, the oldest form which still is retained in use is known as Petit's.

Its action and method of application can be readily enough seen from the woodcut. The strap is first fastened round the limb, not so tight as to make any compression, but sufficiently to prevent the whole tourniquet, or the small pad of lint generally placed underneath the larger pad, from shifting about.

The tourniquet should be unscrewed to its full extent before the strap is buckled.

When pressure is to be made, the screw must be turned very gradually, and great care should be taken that the pad never shifts from its position on the artery.

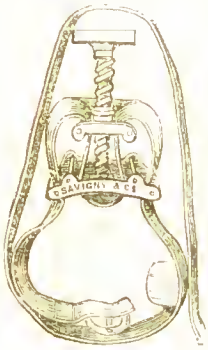


Fig. 69.—*Petit's Tourniquet* (modernized).

It will be noticed that in this pattern, as in the Spanish windlass, in addition to the especial pressure on the artery, the limb is tightly grasped by the strap. In consequence, Petit's tourniquet is very painful, and could not possibly be used for long, as in an attempt to cure a popliteal aneurism by pressure. But the following screw tourniquets have all been designed to free the venous circulation through the limb, by making pressure only between two opposite points.

The principal forms of these are, Signorini's, (Fig. 70), which is easy of application but is liable to slip round the limb; Carte's, or Skey's, (the safest pattern) (Fig. 71) is for the vessels of the thigh, and Lister's, for the abdominal aorta.

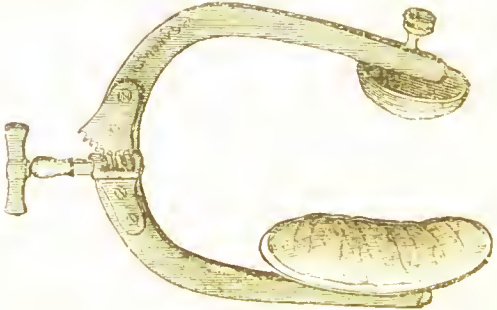


Fig. 70.—*Signorini's Tourniquet.*

An effective tourniquet for the subclavian artery is still much to be desired.

With regard to the use of these tourniquets, the localisation of arteries has been sufficiently dealt with: in all the pressure should be made very gradually, and either a small pad or the finger should be placed over the artery itself, underneath the pad of the instrument.

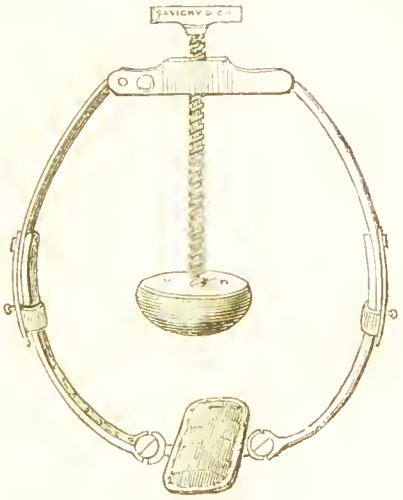


FIG. 71.—*Skey's Tourniquet.*

The compression of the abdominal aorta by Lister's instrument is in itself a serious proceeding, apart from the operation to which it is an adjunct. Some, at any rate, of the important abdominal viscera must be appreciably compressed, and it seems impossible to make sure of avoiding such organs as the main branches of the solar plexus, the pancreas, and intestines, injury to which might well cause a collapse even more serious than that which the instrument is designed to prevent.

For these reasons this tourniquet is not frequently used now. The best way to apply it is for the patient to lie on the right side, while it is put on and roughly adjusted ; in this way the great part of the intestines, etc., escape the risk of pressure. The patient then lying on his back, the artery must be found as mentioned before, and pressure made extremely slowly.

In addition to the elastic band used in Esmarch's method, which has been already described, a solid indiarubber cord fitted into a groove in an ebonite or wooden compress may be used. It is portable and readily applied, but is somewhat liable to slip ; there are two or three patterns on this principle.

SOME OTHER METHODS OF IMMEDIATELY ARRESTING HÆMORRHAGE.

The application of cold to a bleeding part has always been recognised as one of the most valuable means of arrest. Free exposure to the air is often alone sufficient to promote coagulation of the blood, and constriction of the blood vessels. This may be seen in cases of recurrent hæmorrhage after an amputation or any other large cutting operation, when a few hours after the operation the wound or the flaps become distended with blood, which may be dripping away at quite an alarming rate. In such a case if the flaps be opened and the clots cleared out, so that the air can get to the surface of the wound and to the ends of the vessels, the bleeding will very probably cease without anything further being done, provided of course that no big vessel has been overlooked.

Should exposure to air not be enough, cold water or ice (the latter especially), may be very powerful styptics. A lump of ice applied to a bleeding surface may cause an artery, nearly as large as the radial at the wrist, to contract and cease to bleed.

Another very efficient way of applying cold is by

means of the ether spray. The effect of this spray should not be pushed so far as to cause the parts to be absolutely congealed, if this can be helped, for they become very painful on thawing, and the blood vessels being partly paralysed the bleeding is apt to recur.

As a converse to this method of freezing, another way of stopping general oozing is too rarely employed in this country, namely, by the application of a flannel wrung out of water as hot as can be borne by the skin, *i.e.*, about 120° F., but not so thoroughly as to be quite dry, and applied immediately. This should be pressed on the bleeding surface (*e.g.*, to an amputation flap) for a few seconds. On its removal, the tissues will have a whitish look and the hæmorrhage will have all but ceased. The mode of action would seem to be a direct stimulation of the vaso-constrictor nerves, or perhaps of the musculature of the arterioles, as a temperature of 100° to 105°, is known to produce a tonic contraction of muscular tissue.

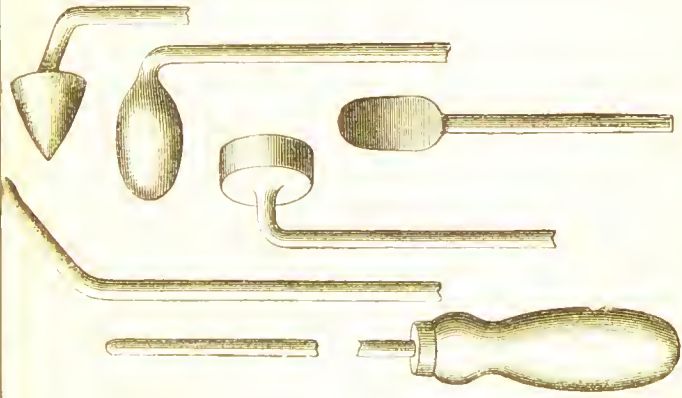


FIG. 72.—*Examples of Cautery Irons.*

The principal forms of apparatus for the application of the actual cautery are the old cautery irons, the

galvano-cautery, and Paequelin's thermo-cautery. Other forms there are, such as the gas cautery of Dr. Bruce, but they are not now in general use.

Cautery irons (Fig. 72) are still frequently employed to stop bleeding, or for the purposes of cautery. They, however, are gradually being displaced by the newer forms mentioned above.

These irons are of precisely the same shape and size as they were in the days of Scultetus, or still further back. They consist of pieces of iron with ends of various shapes, themselves of iron or copper, set into ordinary handles; they, indeed, are just like a white-smith's soldering iron, ending either in a point or a "button," a straight or bent "olive," etc., and the best way to heat them is to put them into the fire.

The most efficient heat for the arrest of bleeding is just a visible red, not glowing, but still plainly red hot. If this heat be exceeded, the iron begins to cut rather than sear the tissues. The iron should be wiped clean from the fire, and the bleeding part itself should be dried as far as possible.

The iron should be passed over the surface very lightly, or the bleeding point should be quickly touched, for contact of the tissues with the iron for more than a moment leads to the parts sticking to the metal, sometimes so much so that they are pulled away with it, and there is still a worse hæmorrhage.

Some form of galvano-cautery is sometimes used for the arrest of bleeding, but the employment of either this kind, or of the cautery irons, is now largely superseded by a thermo-cautery known as "Paequelin's." This apparatus (Fig. 73) depends on the principle that when the vapour of benzoline or some other high olefine is driven over heated platinum, its rapid incandescence is sufficient to maintain this heat very perfectly indeed. In the figure it will be seen that with an ordinary Higginson's syringe and safety ball to give a continuous blast, atmospheric air is blown over the surface of the benzoline, and then being saturated with its vapour, passes on through the tube and through the holder, and

thence into the air through the platinum point, which contains some spongy platinum.

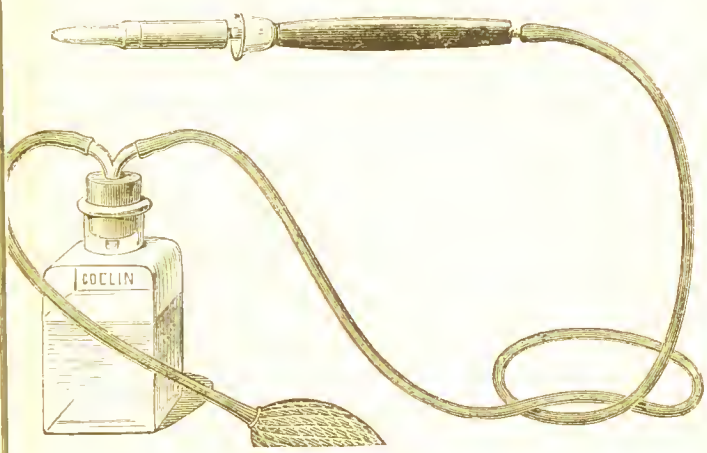


FIG. 73.—*Pacquelin's Thermo-Cautery.*

The platinum point having been first heated in a spirit flame until it just begins to glow, the ball of the syringe is worked by hand, and the air charged with benzoline undergoes active combustion as it passes through the point, and thus not only maintains its heat, but increases it to whiteness.

The readiest way to heat the platinum is to use the spirit lamp as a blow pipe flame, for which it is generally arranged, and, as before, the heat to employ as a styptic is a dull, almost invisible red.

Styptics are substances which, when applied to a bleeding surface, tend to staunch the blood. This they may effect in two or three different ways; thus, they may simply form an artificial scab over the surface, or they may condense the tissues and astringe the vessels by combining with it and coagulating the albumen present; or this condensing action on the tissues may be powerful enough to destroy their vitality, and so by these

"caustics" an effect similar to that of the actual cautery is produced.

The use of styptics was, in former times, far more frequent than at the present time, when it is recognised that any substance which is either caustic, or strongly astringent, inflicts damage to the tissues to which it is applied, and that it should not be used if the hæmorrhage can be otherwise arrested, or merely for the sake of saving a little time or a little blood.

All styptics do not damage the tissues, but all the more powerful ones do, and to a surgeon's eye there are few more irritating causes of offence than to see a clean cut wound, or some unimportant graze, blackened with perchloride of iron or nitrate of silver.

This being understood, the immense value of styptics in proper cases may freely be admitted. The most important may here be enumerated and their application described.

Mechanical Styptics.—The dried leaves of "Piper Angustifolium," or the Matico plant, are imported from Peru, and have a peculiar cobweb-like down on their under surface. Some astringent principle is also contained in the tissue of the leaf.

If the under surface of the whole leaf be applied to a bleeding part, or if the leaves, ground up into a powder, be dusted on it, the fine downy filaments will, with the blood, form a firm adherent scab, and the bleeding will be stanched. This mechanical action is probably the beginning and the end of the "marvellous" action of matico. The infusion or powder taken internally is quite harmless.

In precisely a similar fashion does the domestic remedy act, of gathering as many cobwebs as can be quickly collected, and putting them over the surface; and, indeed, although the remedy may seem too homely for the surgeon to use, of its efficacy in staying a brisk capillary oozing, none who have tried it will doubt.

Collodion, prepared by dissolving one ounce of gun cotton in a mixture of thirty-six ounces of ether, and twelve ounces of rectified spirit, is extremely useful in

cases of wounds about the face, in which, if a scar has to be avoided, the edges have not only to be brought together, but must be held together firmly enough to prevent blood being effused between them. This is readily done by painting three or four coats of this collodion over the wound with a camel's hair brush, or by saturating a piece of lint in it and applying it to the wound. The collodion, as it dries, contracts, and thus the required pressure is kept up.

Flexible collodion, prepared by adding to six ounces of collodion, two drachms of Canada balsam, and one drachm of castor oil, may be used instead of the above. It is not so liable to crack, but it is not so contractile as ordinary collodion.

The next three styptic substances on our list are all astringent, but not at all caustic, that is they do not produce any sloughing. They all are said to coagulate albumen, on which property *plus* their effect on the blood vessels, their styptic action depends. Their application does not necessarily prevent healing by the first intention. These substances are *oil of turpentine, creasote, and hazeline*.

Of these the first two may be "dabbed" on the bleeding surface with some lint. The third may be applied as a lotion, or a pad of lint soaked in it may be placed on the wound.

It is worthy of notice that all three substances are stated to be powerful hæmostatics when taken internally. This is certainly true of the two first, but "hazeline," which is prepared in America from the "witch hazel" (Hamamelis Virginica) is a drug still upon its trial.

We come now to styptics, which, when solid, or in concentrated solutions, are more or less caustic. The most convenient way will be to take them in order of their causticity.

Sulphate of Copper and Sulphate of Iron are both, in the crystalline state slightly caustic, as well as highly astringent, and they are often found very useful in both capacities. Thus, spongy and bleeding granu-

lations may be rubbed over with the crystals, as may also a leech bite or a bleeding gum. In solutions of various strengths they lose their caustic character, but remain highly astringent, and are used then as local applications in cases of relaxed mucous membranes, fungous granulations, etc.

The *perchloride of iron* has quite a specific power as a local application to stop bleeding. The bleeding part may either be touched with the solid salt, or the Liq. Ferri Perchloridi Fort (P.B.) may be brushed over them, or, probably best of all, strips of lint soaked in the same solution may be used to plug the wound or bleeding cavity.

The solid perchloride may also be powdered and dusted on the bleeding surface, while lotions of different strengths, made by diluting the Liquor Ferri Perchloridi, may be used as astringent and hæmostatic applications to the nose, urethra, vagina, uterus, etc. In the concentrated forms this iron salt seems to act by forming a particularly firm spreading clot, it also coagulates the tissues, causes the blood vessels to greatly shrink, and forms clots within them. The parts which are actually in contact with the strong perchloride will die and be cast off in the course of a few days.

Efficient as this styptic is, it is very disagreeable. The intensely astringent taste renders it particularly unpleasant in all injuries about the mouth, and the discolouration and apparent foulness of the wound to which it has been applied, combined with the delay in healing which its use entails, lead most surgeons now to reserve its employment for a last resource; when its value cannot be over-estimated.

Alum and *tannin* in powder are astringent, somewhat escharotic, and rather powerfully hæmostatic. They have a similar action when taken internally, the tannic being changed into the gallic acid. These styptics are commonly applied to bleeding parts in the form of powders, dusted on, but they are still more frequently used as mild escharotics for growths, such

as condylomata. The dried alum (A. exsiccata) which has been deprived of its water of crystallisation, is the more powerful.

Probably the best use of *carbolic acid* as a styptic will be found in checking the general capillary oozing of wounds, by washing them over with a solution of a strength of from 1—15 to 1—25. If a sponge or syringe be used the parts are bathed for a very few seconds. Generally all capillary bleeding ceases, there is no escharotic action, and the antiseptic nature of the solution tends to promote rapid healing.

In all wounds this "washing through" with a strong carbolic lotion, at the end of the dressing, will be found very efficient in preventing excessive capillary loss of blood.

Nitrate of silver or lunar caustic combines with the albumen of the tissues, and when applied in the solid form produces a superficial slough, which is limited in depth, for the silver and albumen compound is hard and dense, and prevents any excess of the caustic that may be present, from causing the cauterisation to be too deep. To this fact its value to a great extent is due.

Lunar caustic is applied in the form of a moulded stick, pointed like a pencil, and held in a metal clip. Its application is almost painless. The point of the stick has but to be held firmly against the bleeding point (*e.g.*, a leech bite, or a dog's bite) for about five seconds, and the bleeding will almost certainly be arrested. It is not suitable for application in this form to a large bleeding surface. This substance is sometimes "mitigated" by the addition of some inert substance, but it is not then used as a styptic, nor are its solutions.

SOME SPECIAL KINDS OF BLEEDING.

We will here mention one or two especially troublesome or peculiar kinds of bleeding, with the best methods for its arrest in the first instance.

Wounds of the Scalp generally bleed very freely at first, but the flow of blood may always be arrested by firm pressure applied directly to the part, which should first be washed and shaved. A compress of lint graduated or not, as preferred, should then be applied and pressure made over it with a twisted or knotted bandage (Fig. 28). The pad should not remain in position more than 24 hours. It is never wise to plug the wound with strips of lint.

Wounds of the palmar arch are very troublesome, and the bleeding from them is very apt to recur. This is due partly to the vascularity of the parts, and partly to the difficulty of applying efficient pressure, the vessels themselves lying beneath, and protected by the thick bands of the palmar fascia.

Although it is difficult to apply pressure, in most cases it is necessary to do so, for other means would tend to cripple the mechanism of the muscles and tendons of the palm. Sometimes no doubt it is advisable to dissect out the bleeding vessel in this crowded region

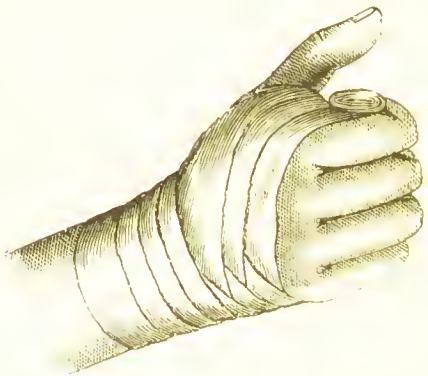


FIG. 74.—*The hand bandaged for a Cut in the Palm.*

and put a ligature on it, but as a rule, the hazards of this proceeding outweigh its obvious advantages.

In applying pressure to the palm of the hand, a firm smooth pad must be used, and the palmar fascia must be relaxed. These two conditions are well fulfilled by bending the fingers over a round piece of wood, such as a ruler, covered with three or four layers of lint, or over a tight roller bandage. If this be firmly grasped, and the fingers bandaged over the cylinder, very good pressure will be made. (See Fig. 74.) Should the bleeding still continue, the forearm should be forcibly flexed at the elbow, with or without the addition of a pad of lint in the flexure of the joint. This will almost always stop the bleeding, but should it fail (and it is wonderful how this form of bleeding will persist) it will be necessary to compress the radial and ulnar arteries at the wrist. This is best done by laying two pieces of wood, *e.g.*, portions of a lead pencil, over two small pads placed on the arteries, and fastening them firmly with strapping, the hand, forearm, and arm being firmly bandaged from below upwards.

Bleeding from a *burst varicose vein* is often one of the most furious, and yet one of the most easily arrested of hæmorrhages. It is important to rightly understand it, for many lives are thrown away every year in consequence of the foolish unreasoning conduct of would-be assistants, when this accident happens.

No one can be long in a hospital casualty department, without seeing some such case as the following. A man who for a long time has had varicose veins, and subsequently a condition of chronic eczema and ulceration of the legs; stupified by cold or drink, subjects the legs to some slight violence, so slight that often it is hardly noticed. Presently he is aroused to the sensation of something warm trickling down the ankle, and looking down he sees his boot and stocking full of blood which is coming from the position of the ulcer. He then becomes faint and falls. A crowd collects, and (the prone position on the ground being the safest for him) they immediately lift him and try to make him sit up. They then get some brandy, and proceed carefully to choke him, while he is unable to swallow.

A bystander then sees the blood trickling along the floor or ground, and so takes his handkerchief and ties it tightly somewhere round the leg, which is still allowed to hang down. The patient being then put into a cab, is driven off to the hospital, perhaps to die before he gets there, as the blood is escaping from his leg all the time.

All this might have been easily avoided by the exercise of common sense. Since the recumbent position is the best for syncope, the patient should not be raised from the ground until a suitable stretcher is provided. Then, the leg being raised a foot or so, the bleeding surface should be exposed, and any constriction round the limb on the "heart" side removed. In all probability the bleeding will practically cease immediately the limb is raised, and a small pad and bandage being placed on the wound, it will not recur while the patient is lying down.

If, however, the patient *must* walk soon after he has had a burst vein, the leg and foot should be firmly bandaged from the toes upwards, to a little above the bleeding point, on which there must first have been placed a pad and bandage. It is also necessary to keep the patient warm; the loss of blood is often very great, and patients such as these cannot bear it well, so that it sometimes happens that after the bleeding has been stopped they get a sudden failure of the heart's action, and die because they have been allowed to get too cold.

Nose bleeding is either idiopathic or traumatic, and is venous and capillary in character. It is of all kinds and degrees of severity, and may require for its arrest a number of expedients, some very simple, some requiring considerable skill.

But it is often desirable not to check the bleeding at all, as when it occurs in children in good health, and young adults of a lusty habit; or in some cases in young women in whom the hæmorrhage is vicarious to the menstrual flow.

Idiopathic epistaxis may be roughly divided into two classes: the one in which it depends on simple

congestion of the mucous membrane of the nose, occurring in healthy people, and the other in which it is a strictly passive congestion, caused by cardiac or hepatic disease.

The hæmorrhage in the first class tends to stop of itself, when by the bleeding the congestion is removed; but in the second the cause is constant, and the longer the epistaxis goes on, the more difficult it is to stop, in consequence of degenerative changes taking place in the blood. The bleeding in these cases is not a brisk flow accompanied with a good pulse and other signs of a strong circulation, but is rather a feeble dribbling, sometimes stopping altogether, and then becoming again a little more rapid. In this way a great deal of blood may be lost by those who can ill spare it, and the bleeding, instead of being a relief, is accompanied by great depression, a feeble fluttering pulse, shallow respiration, etc.

A little experience of the aspect of sick people will enable the student to recognise those who are suffering from visceral disease, whether it be morbus cordis, or cirrhosis of the liver, or chronic Bright's disease, or a malignant growth, and to sharply separate in his own mind those in whom moderate epistaxis is rather a relief, from those in whom it is certainly an alarming symptom, and may be a source of danger. In these latter it should always be promptly checked; in the former, delay is never hurtful and may be useful.

The expedients for checking epistaxis are very numerous, and are best described in order of their importance, and as in practice they should be employed; the simpler measures being always tried before those which cause discomfort or pain.

In the first place, *position* is as important in these cases as in any. The patient's head should never be bent down over a basin, nor should the circulation be stimulated by his remaining standing. The best position is the sitting one, with the head thrown back. A towel spread in front like a bib will prevent the clothes being soiled, and moreover will obviate that

constant blowing and wiping of the nose, which is most harmful.

If, in addition to this position, the venous return to the chest be promoted by everything being made quite loose round the neck,* in very many cases nothing further need be done, and an epistaxis, which has perhaps lasted two or three hours while the head was held down over a basin, will stop in as many minutes. If not, the next thing to do is to raise the arms above the head, or to rest the hands on the top of the head. This has a very good effect, probably by increasing the chest capacity, and thus lowering the intra-thoracic blood pressure in the right heart and the large venous trunks.

The application of *cold* externally is the next expedient. Ice, or a cold evaporating compress is recommended to be put over the bridge of the nose, but it is very doubtful, if this does any good. But cold applied to the *nape of the neck*, is undoubtedly, a very powerful agent for arrest. Slipping a door key down the back is therefore no mere superstition, but its good effects are better secured by an ice-bag fastened over the upper cervical spine.

If these gentle measures have failed, we must proceed to more vigorous ones in the form of local applications to the bleeding part, or as near it as may be, for inasmuch as this is often in the middle or superior meatus, remedies, unless they be very carefully applied, fail to reach the spot required.

The nostrils may first be syringed out with iced water, using a common syringe, or better, one of Higginson's pattern, or a nasal douche (Fig. 75). In using the latter, the water should be forced into one nostril, so that it can flow round the posterior nares, and come out at the other. This is effected by keeping the mouth wide open, so that the soft palate is raised.

* It may be worth while to remind the reader that the collar of the jersey may be tight, while that of the outer shirt looks quite loose. In the case of women it is also wise to loosen the stays.

Instead of iced water, a weak solution of perchloride of iron, say one to two drachms of the liq. ferri perchloridi to a pint of water, or of the sulphate of



FIG. 75.—*Nasal Douche.*

iron, or of alum in similar proportions, may be advantageously used.

Epistaxis may be checked also by the use of solid astringents, as powdered alum or tannin, used as snuffs. The powder, when placed in a paper, folded so as to make a trough, is "sniffed" strongly up the nose. This is a very irritating and disagreeable proceeding, and is

not to be recommended if other means of arrest are at hand.

In cases of continued failure, we fall back on the last resource of plugging the bleeding nostril; for digital compression of any external artery is obviously useless, and compression of the nostrils can only be useful in very superficial hæmorrhages, and these are not common.

The nostrils may be plugged, either from the front alone, or by completely shutting up the nasal cavity on one or both sides, by plugging the posterior as well as the anterior nares, or by means of a nasal tampon or inflating bag.

Plugging from the front alone. We believe that if this operation be thoroughly performed, it will not often be necessary to resort to the disagreeable and not altogether safe practice of plugging the posterior nares. To plug from the front, a strip of lint at least 18 inches long and a third of an inch wide, and a stiff director are required. The strip may be dipped in perchloride of iron solution, or in carbolic oil, if it be thought desirable (the latter is very useful to prevent decomposition), and must then be packed right back to the posterior nares, and the full length of the floor of the nose must be borne in mind.

The back part being well filled, the more accessible parts of the cavity are plugged easily enough, the strip of lint being gradually coiled away until the whole nostril is full.

To plug the posterior nares, a "Belloc's sound" or some substitute for it, will be required, and two suitable little plugs fashioned to fit the anterior and posterior nares respectively. They are best made of lint, tightly rolled, so as to make two cylinders about an inch long and half an inch wide. The one which is to go into the posterior nares, must be tied round the middle with a piece of string, so that two ends, not less than a foot long, hang from it in front, as in the figure (Fig. 76), while another piece, not shown in the illustration, should be fastened to it behind, so that when the

plug is adjusted into the posterior nostril, this may lie in the pharynx, ready to be brought forward out of the mouth when the plug has to be removed. These

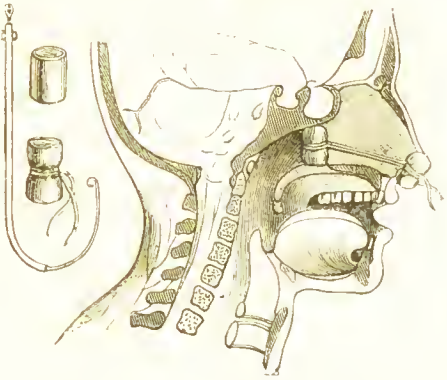


FIG. 76.—*Section through the head, shewing nasal plugs in position with Belloc's sound.*

being ready, the sound, consisting of a cannula, within which is a piece of watch spring, which will curl round the soft palate into the mouth on being pushed out of the tube, is introduced along the floor of the nostril which is bleeding. The watch spring is protruded, and is hooked forward by the forefinger of the left hand, into the mouth, and *both* ends of the string, which are attached to the plug of lint, are quickly passed through the eye, which will be found at the end of the watchspring. This is then retracted into the cannula, and the latter, when withdrawn through the nostril, will carry the strings with it.

The strings must now be separated from the cannula, and drawn through the nostril. The plug will thus be drawn into the mouth and carried backwards to the soft palate ; it must then be passed behind this with the fingers, and pushed upwards into the upper part of

the pharynx, and traction being made on the strings, it can be adjusted by the fingers, to fit into the proper opening of the posterior nares. This being done, the other plug is adjusted into the anterior nostril, *between* the ends of string, which are firmly tied over it and fasten it tightly to the nostril, which is thus converted into a shut cavity.

The principal difficulties in this plugging operation are, first, the introduction of the sound, and the bringing forward of the watchspring, and secondly, the adjustment of the posterior plug. It is often awkward to pass it round the soft palate, but this being done, the rest is easier. Still, it is not difficult to mistake the opening into which the plug is to be placed, and to avoid this, the fingers must be passed right back, and the nostrils thoroughly explored.

Difficult as the application of these plugs may be, once applied, it is impossible for bleeding to continue. Unfortunately, it is not safe to retain them in position long, 36 hours being probably the outside limit: necrosis of the palatine bones, extreme fœtor, and blood poisoning being apt to occur.

It is very rarely indeed that *the socket of an extracted tooth* bleeds to any troublesome extent, considering the enormous number of extractions performed. When it does happen, it is almost always in patients who are either in very feeble health, or else who are affected with some form of the hæmorrhagic diathesis.

Sometimes, indeed pretty frequently the socket of the tooth goes on bleeding for some hours, in consequence of the nutrient vessel being unusually large or unable to contract. In such a case the bleeding comes from one or two points, and is not at all dangerous. In the really serious cases, from the whole gum and lining of the socket there appears a general welling up of blood, and this is sometimes hard to check. An "alveolar tourniquet" has been invented for the purpose, but it is now hardly ever used, and reliance is placed on conscientious plugging, and the actual cautery.

In plugging, lint or cotton wool is generally used, either plain, or dipped in some styptic, such as turpentine, carbolic acid, creasote, or alum. In any case it must be packed away very firmly indeed, filling the whole socket, and a little more, so that the plug may be kept in proper position by the opposite tooth, if the jaws be closed with a four-tailed bandage.

Another plan is to *replace the extracted tooth*, if it has been kept, and this often answers very well. Every surgeon, however, may come across cases in which the repeated hæmorrhages are endangering the life of the patient, from even such a trivial cause as this. These extreme cases will generally be found to be associated with well marked hæmorrhagic diathesis, and in many instances constitutional treatment has been found a most important accessory to local measures. Probably of these latter some form of the actual cautery will be found the most useful.

Recurrent, or reactionary hæmorrhage, is that form which comes on as soon as the period of lowered cardiac action and partial collapse, which is occasioned by the shock of an operation, or of an accident, passes off, *i.e.*, within four or five hours of the injury. By this time, too, the contraction occasioned by the exposure and division of the vessels, has largely passed away. There is then present a condition of increased cardiac activity and relaxed vascular walls, so that it is not surprising that very frequently there is free general oozing from a wound, which at the time it was done up appeared quite dry. The bleeding is chiefly capillary, or proceeds from small arterioles, which had been so firmly contracted as not to declare their presence at the former examination. Now, too, larger trunks which have been tied, but not very firmly, may burst their bonds and bleed freely.

In the majority of these cases, raising the limb and putting some increased pressure on the wound, will be all that is required; as the condition of over-action passes away, so will the bleeding cease, and if it be very slight, nothing at all need be done. If however

it should continue, the effect of an ice bag over the part should be tried; this failing, the dressings must be undone and the wound exposed. It may now be syringed out with cold water, and a few minutes' delay granted to see its effect. Should the hæmorrhage still go on, the wound must be opened up and the clots cleared out; it will then be seen whether the hæmorrhage proceeds from any vessels requiring torsion or ligature, or whether it is purely capillary. If the former, the vessels must of course be secured; if the latter, the clearing out the clots will have had a very good effect, and this, with a few minutes' exposure to cold, or the application of a hot flannel (as before described) will be sufficient to arrest the bleeding. The wound must be then redressed and put up rather firmly.

It must be recollected that a smart reactionary hæmorrhage, and the means taken for its arrest, may be sufficient to cause a collapse, similar to the original one. The bleeding will then cease as it did before, and from the same causes, and it may also be succeeded by a reactionary state, sufficient to cause a further loss of blood.

In these cases, therefore, after reactionary hæmorrhage has once occurred, the patient should be watched.

Chapter IX.

THE FIRST TREATMENT OF SHOCK, OR COLLAPSE, FITS, ETC.

Shock, or collapse. We will take first, cases of *shock from severe injury without hæmorrhage.*

The slow, feeble, or almost annihilated pulse, the pallor of the lips, and coldness of the extremities, the mental hebetude, the anæsthesia of the surface, the relaxation of the sphincters, the lessened secretion of urine, the impaired muscular action, all point to a state of seeming *lifelessness*, and it is this which gives the clue to the line of treatment. The weakened heart can barely keep its own and the respiratory centres going, still less the cerebral cortex. The head must therefore be as low, or lower, than the rest of the body, and artificial respiration must be performed if necessary. The feeble circulation fails to maintain the heat of the body; so it must be supplied from without. There is a danger of the heart stopping altogether; therefore it must be directly or indirectly stimulated.

In practice, the first thing to do when a patient is collapsed, is to get him to bed, between the blankets, and with the head quite low. Hot-water tins, or hot bricks, should then be put in the neighbourhood of the flanks, and between the thighs, care being taken not to scorch the skin, while the patient is too insensitive to complain. The further measures will depend upon the severity of the shock. In slight cases, when the feeble pulse steadily gathers strength and the respiration continues regular and becomes gradually deeper; in fine, when it is evident that the condition is rather one of a temporary lowering of vitality than of apparent *lifelessness*, few further measures can be taken which will be useful. Rest and warmth, and lying flat, will do all that is wanted.

Cases of a higher grade of severity are those where

the patient can be roused to swallow, and has a fair respiration and a perceptible pulse, but still, after a little watching, does not appear to be coming round, or may seem to be getting worse. (For shock is eminently a relapsing condition.) In these cases, sal volatile, ether, alcohol, or some other diffusible stimulant should be given in small doses, frequently repeated, and of these, sal volatile is probably the best.

Most cases of shock will fall under one of these two heads, and with ordinary attention, in the absence of other complications, they will do well enough.

But more rarely, cases occur in which the collapse, the lifelessness, is much more profound, and then every exertion will be necessary to prevent the life going out altogether. In these, the respiration will be threatening to stop at every moment, or may actually have stopped, the pulse will be barely, or not at all perceptible at the wrist, the temperature may be lowered below 90°, and the insensibility profound.

In such a case we must not wait for the natural breathing to stop, before artificial respiration is set up. The head should be placed well below the level of the legs and body; frictional warmth procured by hand rubbing; while the heart may be directly stimulated by a hot mustard plaster, or by a turpentine stupe, and the diaphragm by faradisation.

As soon as the patient can swallow, stimulants should be given, but the risk of choking an insensible person must always be kept in mind. Another method of administering stimulants, however, is now coming into general favour, and is of extreme value in these cases, namely by *hypodermic injection*. The effect of the intra-venous (or hypodermic only) injection of 10 or 15 drops of ether, or of ether and brandy in equal parts, into the arm, is very striking indeed, and in many cases has undoubtedly saved life. Stimulant enemata are sometimes very useful. Even in cases of apparently total collapse it should be kept in mind that there may be only "suspended" animation, and it is right

to proceed with all approved methods of resuscitation before pronouncing the condition to be hopeless.

Care must be exercised not to over stimulate when the effect of the collapse begins to pass off, and to leave as much as possible to *rest* and *warmth*. The collapse will in any case be followed by a reactionary period of irritation and generally of fever, and this may be much aggravated by injudicious treatment at the first.

The general effects of extreme and sudden hæmorrhage are recognised as being to a large extent identical with those of true shock; nor do the two conditions differ generally in their treatment, except with regard to the question of transfusion, which we do not here consider.

Syncope. Inasmuch as faintness is due to partial cerebral anæmia, brought on by failure of the heart's action, within certain limits, the treatment is the same, whether the syncope be merely emotional, or be due to some more definite cause, as general exhaustion, cold, hæmorrhage, organic disease (especially cardiac valvular incompetence), or a combination of any of these.

As an example of the common fainting fit, we may take that form which occurs most commonly in young women or lads of feeble circulation. Such people, under conditions of bad ventilation, disagreeable sights or smells, fatigue, or of an empty stomach, are liable to attacks of simple syncope. They have a sudden feeling of nausea and giddiness, and fall unconscious to the ground. On examination there is found a marked pallor and moistness of the face, shallow but distinct respiration, a pulse just perceptible at the wrist, and a peculiar flaccidity of the limbs. The eyelids are half open and the lips parted.

Presently, if left alone, the colour will return to the cheeks, the respiration become deeper and sighing, the eyes will open, and consciousness will return.

Of a similar nature, but even more transitory, is the purely emotional form, which occurs in perfectly healthy, strong people. Thus, grown men often faint on being vaccinated, or at the sight of blood.

Although none of these forms of syncope are dangerous, it is well that the attack should be as short as possible. The great agent in the recovery is an improvement in the cerebral circulation, and the best way to effect this is to make the brain the lowest part of the body. The patient must therefore be kept lying down (the position naturally assumed), and in every way freedom of respiration and of the circulation must be attained.

External stimuli, such as smelling salts (not too strong), the sprinkling of cold water on the head, slapping the hands, etc., must be resorted to, but stronger stimulation, as faradisation, is not required. Fainting may often be prevented if the patient be sitting at the time of the attack, by making him lean well forward, so that the head comes almost between the knees, and thus receives a good blood supply. Perhaps, too, the aorta is partly compressed by the flexion.

But although the milder kinds of syncope are not alarming, faintness may be a condition of the greatest danger, and is indeed one of the most frequent actual causes of death. We have examples of such extreme syncope as an effect in great exhaustion from exposure, or in starvation; or it may be due to the exhaustive effect of some severe illness.

If these cases be left to themselves, they will often insensibly drift onwards into death, and active measures must be taken to prevent this. The actual details of treatment will differ according to the particular cause in each case, but in almost all respects they are identical with those for extreme hæmorrhage, or for shock, or for drowning; namely, lying flat, warmth, stimulation, injection of ether, etc. In addition, in very severe forms of syncope it is often useful to *invert* the patient, so that the head is the lowest part of the body. This is most conveniently done by placing the legs on a couch, and the head and shoulders on the floor. (This method of resuscitation is called "Nélaton's"). Artificial respiration, Faradisation, and auto-transfusion, *i.e.*,

emptying of the limbs of blood by hand rubbing and elevation may all be sometimes required.

Hysterical Fits. Although no two of these attacks are alike, there is rarely any difficulty in the diagnosis: indeed it is only when the attack exhibits the more serious characters, of what is termed *hystero-epilepsy*, that any doubt can arise. In ordinary cases the flushed tearful face, the panting breath, the emotional laughter or sobbing, the jerking movements, not truly convulsive, and the almost invariable termination in a flood of tears, and (though this is naturally not so evident) with a profuse secretion of almost colourless urine; all these points are characteristic of the hysterical attack, and could not occur in a real fit.

Moreover, if there be any doubt, analysis of the symptoms will show that the condition is a mimicry of graver disease, and that there is a "contrariness" in the behaviour of all these patients, which is very characteristic. Try to open the eyes, and they will be screwed up: or the mouth, and the teeth will immediately be clenched; the tongue, however, never being bitten. So, if an effort be made to sit the patient up, she will immediately flop down on the floor, but in doing so will give a further evidence of the nature of the attack, for in falling, even though there be apparently a loss of consciousness, the patient will carefully guard herself against injury.

Apparent unconsciousness is often present, and a kind of anæsthesia, so that needles may be run deeply into fleshy parts without eliciting a sign of pain; yet both these states are really deceptive. The anæsthesia is the result of an exaltation akin to the ecstasy of a flagellant, and the unconsciousness is only on the surface. In fact, as in the conditions of hypnotism (which in many other respects resembles hysteria), there is quite an abnormal intelligence of surrounding affairs. No hysterical woman, though she may be to all appearance profoundly unconscious, would ever allow anyone to cut off her hair. Moreover, while this emotional condition lasts, patients are very completely

"*en rapport*" with the state of mind of those around them, and promptly become much worse, or speedily recover, according to the behaviour of the bystanders.

Although we have said that the symptoms are a mimicry of other disease, no greater mistake can be made than to treat these sufferers as malingerers. The illness is real enough, although it is a moral, rather than a physical ailment; and although the symptoms be not genuine, the object to be attained is to cut the attack as short as possible, and to diminish the chances of its recurrence. On the one hand, the tendency to recur will be increased if the symptoms are treated as if they were signs of a grave mysterious illness, and on the other, the severity of the present attack will very likely be aggravated by harshness or rough treatment. The "bucket of cold water" we believe to be always harmful, but so is the other extreme of profuse sympathy, mixed with restoratives such as sal volatile, or chloric ether, or with comforting glasses of hot brandy and water.

As we have stated before, hysterical people may be quite well trusted not to hurt themselves, so in almost all cases the best thing to do is to leave them alone. Nothing conduces more to a quick recovery than that the patient shall be convinced that her condition is one which excites no alarm, no pity, and no anger; and bearing in mind how hyper-sensitive these patients are to external conditions, all fussy friends should be rigidly excluded. Indeed, there is no necessity for anyone to remain in attendance, and if the patient be simply laid on her bed at the commencement of an attack, and left to come out of it as soon as she will, nothing better can be done.

A mixture of hysterical and alcoholic excitement is not uncommon in hospital casualty rooms. These cases again may be left to themselves or may often be more quickly restored to their right minds by a brisk emetic.

The unconsciousness which is due to a distinct injury to the head may be of the kind known as *concus-*

sion or stunning, or it may be due to the compression of some part of the brain by a portion of the skull which has been driven in upon it; or by a collection of blood effused between the brain and its membranes, or the membranes and the bone, or within the brain substance.

With regard to the latter of these two forms, as we are considering the question of *treatment* only, we need not stop to distinguish it from that kind of comatose unconsciousness which is brought on by an attack of apoplexy, and which is presently to be described.

The former condition, of concussion or stunning, appears to be a transient abolition of the higher cerebral faculties, brought on by a mechanical shaking up of the brain substance, without the infliction of structural injury. While concussion lasts the unconsciousness is absolute, while many of the symptoms of general shock are present. Vomiting very generally occurs as the condition passes off.

It is rare for the stunning to last many minutes, the reported cases of prolonged unconsciousness due to brain concussion being probably due to some definite structural brain lesion.

As for the treatment, the points to be recollected are almost entirely negative ones. No effort should be made to restore consciousness, but on the contrary, the shaken brain cells should be allowed the most complete repose, and darkness, silence, and such warmth in bed as may be necessary to promote recovery from the shock are indicated. After the actual concussion has passed away, it is always wise to keep the patient quiet, with a simple diet, and to avoid excitement and brain work, for the remote effects of concussion may be serious, although the immediate stunning may have lasted hardly more than a few seconds.

Two great groups of attacks, or states of disease, are especially designated by the common term of "*fits*," although as every one knows, the name is applied to many other conditions as well. Those are the two *apoplectic*, and the *epileptic* state, and the first certainly,

and probably both, may be produced by very various causes.

As effectual causes of the apoplectic state, we may have *hæmorrhage* (the commonest), causing the attack either through brain shock, pressure, or laceration; *uræmia; acute alcoholism*, or the circulation of some other poison in the blood; or *rapid serous effusion* on the surface of the brain; (the existence of this serous apoplexy is now much questioned), and we also find cases of so called *simple* apoplexy, in which the exciting cause of the fit cannot be traced with certainty.

But the apoplectic state or *fit*, from whichever of these causes it may arise, will present very much the same symptoms; namely, *of loss of consciousness without failure of the heart's action*, while, in the vast majority of cases, there will be evidence also of some local cerebral lesion in the shape of convulsive movements, or paralysis, or both, the paralysis generally remaining after the actual fit has passed; inasmuch as we have only here to consider the practical management of the patient during the attack, a differential diagnosis is not at all necessary.

Taking the case of an apoplectic fit arising from cerebral hæmorrhage, its course will be something like the following.

After a varying prodromal period, during which there may have been warnings, in the way of mental confusion, giddiness, etc., the fit proper generally comes on quite suddenly, often during some emotion, or some unusual exertion. The prominent system is the complete loss of consciousness, but preceding this, there may be a short period of convulsive twitchings of the face or limbs. When consciousness is lost, the patient falls to the ground, the breathing becomes laboured and stertorous, with a flapping in and out of the cheeks, caused by their paralysis, and by that of the soft palate. Commonly one side of the body, and the opposite side of the face and tongue will now be found to be partly convulsed, partly paralysed. As the fit continues the paralytic symptoms become more de-

veloped, and with this there is steadily deepening coma. Reflex is nearly or quite abolished, and the pupils may be widely dilated, or unequal, or small, but are generally fixed, and in any case, do not react to light.

The pulse as a rule is full and slow. The larger venous trunks are often distended. (This is the condition in hæmorrhagic cases. In uræmic fits, pallor, and a small pulse are frequently present.) In such a case the coma may get steadily deeper and end in death, without any effort at a rally, in a few hours or days. If this does not happen, after a period so variable that no estimate is possible, there is a gradual lightening of the coma, twitchings cease, and reflex gradually returns. Later, the patient can be partially roused, and then returns to a state of consciousness. This, however, is rarely at first unclouded, and with it there generally comes the appreciation of permanent paralysis of the limbs or face, and often, aphasia in some one of its forms. The after history of the case is generally one of improvement.

Bearing in mind the usual cause of this condition of apoplexy, it will be plain that all direct attempts at rousing or restoration of consciousness will not only be futile, but will be actively harmful. The first and great point in the treatment will be to get the circulation as quiet, and the heart's action as free from embarrassment as is possible. A "do nothing" policy is therefore on many points essential; but, except in the more transient and slighter attacks, or on the other hand, in those cases of *apoplexie foudroyante*, in which death occurs almost immediately, there are certain indications for relief of the cerebral circulation which should, if possible, be fulfilled.

There will be little difficulty in recognising whether the case be one in which nothing is required except absolute rest and quiet watching, or whether more active treatment be called for. In the latter case, the chief measures are the local application of cold to the head, blood letting, and free purgation. If the

head be hot, or the face flushed, it can never be unwise to cut the hair short, and apply an ice bag, or cold water.

Such measures as bleeding, leeching, wet or dry cupping, or a free, drastic purging may, any of them, be ordered by the responsible medical officers, but in the majority of cases of apoplexy, the one thing needful in the first place, is to keep the patient still in bed, with the head slightly raised, in a dark room, taking particular care that there be no obstruction to the respiration.

The practical management of an *Epileptic Fit* may be very shortly described. In the epileptic, as in the apoplectic state, the prominent feature is the absolute loss of consciousness. The attacks also vary infinitely in their severity and duration, from those cases of *petit mal*—in which there is a momentary confusion and loss of consciousness, gone almost before it is felt —to the most violent storms of convulsions, lasting, it may be, a full half hour. The following may be taken as an account of a moderately severe epileptic fit.

Quite suddenly, or after some subjective premonitions, as of a creeping sensation, or travelling wave of coldness or the like, which is known by the name of an "Aura," the patient becomes unconscious and falls to the ground, often with a cry or groan. Almost all the body is then thrown into a state of tonic convulsion; the respiratory movements are arrested with the others, and the patient becomes more or less asphyxiated. The asphyxia however, seldom becomes extreme, and after a time, shorter than it appears to the lookers on, the tonic contraction passes over into a state of general clonic convulsion, in which the limbs are tossed hither and thither, damage to them being often inflicted. At this stage, too, the tongue may be bitten, or the nails driven into the palms. Gradually, and generally after a very few minutes, the convulsive movements quiet down, and a condition resembling coma, but which only in the most severe cases is true coma, follows. Soon this comatose state

passes into one more like natural sleep; the asphyxial colour disappears, and as a rule, the patient wakes up within half an hour or an hour, ignorant of what has happened, unless previous experience has taught him to understand the position of affairs.

In such an attack, nothing ought to be done with the idea of any restoration to consciousness, and all that is called for, is to see that during the convulsions the patient does himself no injury, either by tossing his limbs or head about, or by getting into such a position that respiration is interfered with. Anything tight about the neck, chest, or abdomen, should be loosened, and especial care should be taken that the tongue does not get caught between the teeth. If this happens, the jaws must be forced open, and a piece of cork, or wood, or some other suitable wedge inserted to keep them apart.

Strenuous efforts at restraint of the convulsions appear rather to excite them, and are never necessary. As soon as the violence of the fit is over, the quieter the patient is left the better, and if natural sleep follows, it should be encouraged to last as long as possible. On waking up, if any signs of exhaustion are present, a little soup or beef tea is useful, but no alcohol.

Epileptic malingering. In hospital practice the house surgeon or dresser must be on his guard against being deceived by malingerers, who feign to be epileptics in order to obtain admission. The only way to detect them with certainty is to be thoroughly acquainted with the symptoms of the genuine attack.

Foaming at the mouth may be simulated by soap, and much "lather" about the lips is in itself suspicious; but the crucial point is the insensibility. In genuine cases this is absolute. Many malingerers are aware of this, and will bear pain inflicted as a test, with a fortitude worthy of a better cause, but faradisation judiciously applied can hardly be resisted for more than a few moments.

The Convulsions of infants. The equal balance

of the cerebral government is, in infants, very easily upset, and convulsive attacks may occur from very slight causes. Worms, teething, intestinal irritation, cerebral irritation, as in rickets, or some local irritation, even that of a pin, may, any of them, be sufficient to bring on an attack. On the other hand, the fit may be an indication of the gravest brain disease, or may stand in the place of the initial rigor which in adults heralds the onset of some acute fever.

But the "infantile convulsions" which we here consider, are epilepti-form fits, arising as a reflex from such local and temporary causes as we first mentioned, and although they are alarming, are seldom permanently harmful.

Taking as an example, the convulsions caused by the irritation of the gums during teething, we shall find that the child, after being hot and fretful for some hours previously, is noticed suddenly to "look queer," or to squint. A general spasm of rigidity then passes over the body, the face becomes pale and set, the eyeballs are turned inwards, and respiration is almost arrested, in consequence of which an asphyxial look quickly develops. This rigidity, however, generally lasts only for a few seconds, and is succeeded by twitchings of the face, and other clonic convulsions. These again quickly subside, and the child falls into a sleepy, semi-comatose condition, which soon becomes a natural sleep. Consciousness is quite abolished during the fit itself.

This is an account of a rather severe fit, and they are found of all degrees. Often the whole attack is compressed into a momentary loss of consciousness, with a spasm of rigidity, followed by a little drowsy heaviness. But in all, except the very slightest, the condition is certainly one which must be hurtful to brain action; the cerebral circulation, therefore, should be relieved if possible, and that quickly; such relief can be given most directly and readily by putting the child into a hot bath *at once*, at as high a tem-

perature as can be borne (say 103° Fah.) If this can be got directly, the child may with advantage be put in clothes and all, and undressed in the water. It should be immersed up to the neck, and a sponge of cold water may be placed at the back of the head.

Indirectly, too, the bath fulfils several good purposes. The undressing of the child will enable a thorough examination to be made, and will discover if, by any carelessness, there be a pin running into the skin, or any other local irritation. Possibly the warmth may hasten the appearance of the rash of some fever, or if there be intestinal colic, this will be relieved.

Chapter X.

of restoration from drowning, etc.

In all forms of asphyxia it is important to recollect, first, that insensibility comes on very soon, some time before the convulsive struggles cease, and is succeeded by a paralysis of all the voluntary muscles, including those of respiration; and secondly, that the heart's action may continue for a long time after the ordinary muscular movements are abolished.

It will probably save needless repetition if we here consider the steps to be taken with the object of restoring suspended animation in ordinary cases of drowning; and taking this account as a typical case of suffocation, to leave it to the reader's common sense to fill in the details of the slight variations which are called for by the different circumstances of other forms.

In *drowning*, several causes are generally present to produce a condition of lifelessness, in addition to the asphyxia itself. Thus, *shock* is often present and may be a very important factor. *Exhaustion* from long-continued struggling, and the effects of *exposure to cold*, are also common, and have to be dealt with.

Still, the great agent in producing the condition, is suffocation, and this must first of all be combatted.

Supposing, then, that the body of an apparently drowned person has been recovered from the water, and that respiration is found to have stopped, it may well be that the breathing can be set going again by simply making sudden forcible pressure at the pit of the stomach some three or four times, at intervals of three or four seconds; but should this not be quickly followed by respiratory movements, artificial respiration proper should be at once begun.*

* It is generally best to do this on the spot, but if a shed or house be close at hand, the loss of a few moments may sometimes be risked, in view of other advantages.

For this method to be of the least avail, all its details must be carried out regularly and thoroughly; the object being so far to imitate the natural thoracic and abdominal movements, that air may be sucked into, and squeezed out of, the chest.

The three principal ways of doing this are known as "Sylvester's," "Marshall Hall's" and "Howard's."

In Sylvester's method (Fig. 77) the arms are used as levers, acting so as to expand the chest walls by means of the muscles placed between the limbs and the trunk, the origins of the muscles acting now as insertions, and *vice versa*.

The patient should first be laid on his back, and some convenient support be placed under the shoulders, so that the chest may be thrown out, and the neck extended, with the head thrown back. (See illustration.) If this be properly managed, there will not



FIG. 77.—*Sylvester's Method of Artificial Respiration.*

generally be any necessity for the tongue to be drawn out of the mouth, for the larynx will be kept open by the chin being kept well up. But it may sometimes be desirable for an assistant to draw forward the tongue,

and if so, the best way to hold it, in the absence of proper forceps, is with the corner of a handkerchief between the finger and thumb. This is much better than trying to fasten the organ down to the chin with an indiarubber band, or running a hair-pin through it, as has been recommended.

Everything which in the least confines the neck, or chest, or abdomen, must be loosened, and the mouth and nostrils cleansed from any mud, etc. Should there be any water lying in the pharynx the patient may be turned over on one side to let it run out of the mouth, but no direct attempt should be made to empty the stomach.

These preparations should only occupy a few moments. The surgeon then kneeling at the patient's head must take hold of the arms above the wrists, and carry them well over the head right back as far as they will go, as shewn in the figure. The chest walls will then be expanded, and generally air can be heard passing through the glottis. The arms must then be brought down against the sides, and the forearms crossed over the pit of the stomach. Leaning now with his weight upon them, the operator makes forcible pressure upon the abdomen, so as to press up the diaphragm, and this should elicit a distinct grunt from the patient; if it does not it is doubtful if air has entered the chest cavity at all; the whole process is then repeated.

The rate at which artificial respiration should be made varies with the age of the patient, and should be about the rate of normal breathing for that age, say, for an adult, 17 times a minute.

If recovery be going to take place, generally a very few minutes will be sufficient to restore natural breathing movements, and then care must be taken not to interfere with the short gasps with which natural respiration begins; but the patient must still be carefully watched, for the condition, like that of shock, is one very prone to relapse, and the respiration may fail again after it has been restored.

While this principal restorative process is being carried out, other secondary aids to recovery should be attended to. These do not differ greatly from those already described for shock.

A warm bath should be prepared, and the dripping clothes exchanged for dry warm blankets. Frictional warmth is a very useful agent, and the extremities and flanks may be energetically rubbed in the direction of the venous circulation.

As soon as respiration has been fairly established, the hot bath, if procurable, may be used. The temperature must be high, say 104° Fah., and the time of immersion short. The patient may then be put to bed between blankets, with hot water bottles, and some stimulant, such as hot brandy and water may be given, especially if there be still feebleness of the heart's action, or shivering.

Marshall Hall's method is generally said to be easier for one person to perform unaided if the patient be heavy, or the operator weak. Whether this be so or not, it is, we believe, certainly less efficient. For its performance, the body is rolled half over from the position of lying on the back, to that of lying on the side, when the arm which is uppermost, is pulled forwards out of the way, and pressure is made on the side of the chest to expel as much air as possible (the expiratory movement). The body is then rolled over on to the back (the inspiratory movement) and these manœuvres are repeated at the same rate as in Sylvester's method.

The following are the rules of procedure for *Howard's method* :—

1. *Instantly* turn patient downwards, with a large firm roll of clothing under stomach and chest. Place one of his arms under his forehead, so as to keep his mouth off the ground. Press with all your weight two or three times, for four or five seconds each time, upon patient's back, so that the water is pressed out of lungs and stomach, and drains freely out of mouth. Then :—

2. *Quickly* turn patient, face upwards, with roll of clothing under back, just below shoulder blades, and make the head hang back as low as possible. Place patient's hands above his head. Kneel with patient's hips between your knees, and fix your elbows firmly against your hips. Now—grasping lower part of patient's naked chest—squeeze his two sides together, pressing *gradually* forward with all your weight, for about three seconds, until your mouth is nearly over mouth of patient; then, with a push, *suddenly* jerk yourself back. Rest about three seconds—then begin again, repeating these bellows-blowing movements with perfect regularity so that foul air may be pressed out, and pure air be drawn into lungs, about eight or ten times a minute, for, at least, one hour or until patient breathes naturally.

Note.—The above directions must be used on the spot, the first instant the patient is taken from the water. A moment's delay—and success may be hopeless. Prevent crowding around patient; plenty of fresh air is important. Be careful not to interrupt the first short natural breaths. If they be long apart, carefully continue between them the bellows-blowing movements as before. After breathing is regular, let patient be rubbed dry: wrapt in warm blankets—take hot spirits and water in small occasional doses, and then be left to rest and sleep.

Dr. Howard claims a superiority for his method for the following reasons:—

1. The direct method alone provides for a thorough preliminary ejectment of fluids from the stomach and thorax.

2. This method alone makes the drainage of the pharynx constant, precluding failure from lodgements there, or suction thence into the trachea.

3. In this method the usually impracticable task of opening the mouth and pulling forward the tongue is more than superseded by simple position.

4. This same position also secures, and that in the only way possible, the instant elevation of the epiglottis.

5. The compression by this method is the most complete, and capable of the most delicate adaptations.

6. It is the only method which can be practised by one person, and which by the same person can easily be continued as long as it may be of use.

In *suffocation by the fumes of charcoal or coke*, by the *carbonic acid in brewery vats*, or by the *choke damp* of mining accidents, or in cases of *hanging* other than those performed by the public executioner, we have examples of suffocation, in all of which the great agent for resuscitation must be artificial respiration. As a rule the conditions are more simple than in drowning, as shock, or exhaustion, or cold, the effect of which in drowning have to be overcome, are not generally present, but the main principles of treatment remain the same.

In asphyxia, as in other forms of suspended animation, the muscular fibres of the heart and of the muscles of respiration may be stimulated to contract by an electrical current; the following directions for its application are given by Beard and Rockwell.

The faradic current is usually employed, but the interrupted galvanic current might answer the purpose.

Graduate the current to a strength sufficient to produce vigorous contractions of the muscles of the ball of the thumb. Then press the electrodes firmly over the phrenic nerves, between the sterno-mastoid and scalene muscles; or, put one electrode over one phrenic nerve and the other in the seventh intercostal space.

Interrupt the current about three times a minute, while the assistant presses firmly on the abdomen, pausing occasionally to observe the effect.

If no inspiratory movements appear after a number of interruptions, increase the strength of the current.

The electrodes must be large, and well moistened.

Chapter XI.

of the treatment of cases of poisoning.

Of *Poisons.* We have now to consider the measures which should be taken when some one of the substances which are commonly used as poisons, or which may be so used, has been taken into the body in sufficient quantity to produce toxic symptoms. The following are the chief of these substances, and we will consider them in the order in which they are here given.

General Poisons.	*Irritant Poisons and Caustic.*
1. Alcohol.	1. Carbolic, Oxalic, Sulphuric, and other — Acids.
1a. (Ether.)	2. Corrosive sublimate.
2. Kerosine oil.	3. Arsenic.
3. Opium.	4. Antimony.
4. Stryehnia.	5. Phosphorus.
5. Belladonna.	6. Caustic alkalies.
6. Prussic Acid.	
6a. (Nitro-Benzol.)	
7. Chloral.	

Poisonous Food.

Shell fish. — Mushrooms.

The general poisons vary too greatly among themselves to admit of any general description, and must be considered separately.

Alcoholic poisoning may be conveniently divided into *drunkenness* and *acute alcoholism.* The former is not in itself dangerous, and usually the best course to take with drunken men or women is to leave them to sleep the effects of the alcohol off. Nevertheless, even a

moderate grade of drunkenness may be dangerous in old or feeble people, with degenerated tissues and weak circulation, for it may be the cause of a grave cerebral disturbance (generally of the nature of a serous apoplexy), or of a failure of the heart's action. The latter event must be particularly guarded against in cold weather, for, in consequence of the dilated condition of the arterioles of the skin, drunken people lose heat very quickly. Care must be taken, therefore, in thus leaving drunkards alone, that their conditions are such that there is no chance of their getting dangerously cold.

It often happens in the casualty department, that it is desirable to make a patient sober as soon as possible. For this purpose nothing is more effectual than a brisk emetic. Sulphate of zinc, sulphate of copper, or tartar emetic may be used in sufficient doses.* If the patient be violent or refuses the draught, it may be given with the stomach pump (the use of which is described later), but in practice it will be found that if the pump has to be used at all, a sufficiently sobering effect will be produced by washing the stomach out with two or three pints of warm water. In certain cases, a hypodermic injection of one-tenth to one-eighth of a grain of apomorphia may be administered. Although this emetic is generally reserved for graver cases of poisoning (*vide infra*), still it appears to be perfectly safe.

For the common occurrence of a drunken and disorderly person being brought to the hospital, and refusing to give his or her name and address, faradism, strong enough to produce painful contraction of the muscles, will generally prove effectual when the proceeding is really worth while.

* An effectual but a very nauseous draught was, and probably still is, used at St. Bartholomew's, under the name of "half-and-half." It consisted of 30 grains of sulphate of zinc in ℥i ss of water, added to an equal quantity of house physic (Hst. Sennæ Co., P.B.).

A short experience will enable any one to separate ordinary cases of drunkenness from other forms of poisoning, and we need not particularise its symptoms. It is undesirable also to attempt a hard and fast differential diagnosis between the higher grades of acute alcoholism, and other grave conditions, but this is for a different reason, namely, because it is now not an alternative question, drunk? or dying? but a positive statement, drunk *and* dying. Any patient who has swallowed enough alcohol to produce symptoms which may be confounded with apoplexy or any other severe illness, must be considered to be poisoned, and to be in need of careful treatment.

In these cases of acute alcoholic poisoning, the condition of the circulation and respiration will be the best guide as to whether the patient may be left to recover from his stupor without further measures beyond those which are required for keeping him warm, or whether the stomach pump should be used; but in most cases it will be best to wash the stomach out with warm water, and this should always be done if there be any sign of failure of the heart's action, or if the breathing be suspiciously shallow. Alcohol may remain for a long time nearly unchanged in the stomach, and should therefore be removed, to prevent further absorption. In extreme cases, artificial respiration may be called for, but these are generally speedily fatal.

In acute alcoholic poisoning, as distinguished from simple drunkenness, if the stomach pump be not at hand, emetics may be used, but as it is undesirable to further irritate the already injured stomach, preference should always be given to the pump if possible. This irritable condition of the stomach should always be kept in mind in the treatment of the case after the acute stage has passed.

Intoxication by drinking *ether* is hardly known in England, but is stated by Dr. Richardson to be common in some parts of Ireland. As a result of inhalation, it is of daily occurrence in all hospitals.

When it is swallowed, its effects nearly resemble those of alcohol, but the period of excitement is more marked, and that of stupor less so. It is much more rapidly eliminated, so that the whole intoxication is shorter, and is less poisonous, although Dr. Morshead, of Draperstown (the head-quarters of ether drinkers), has recorded four fatal cases. Its treatment does not differ from that for alcoholic poisoning.

Almost the same may be said of a form of poisoning now getting more common, namely by *kerosine*, or some mineral oil. When this is swallowed it produces flushing and excitement, followed by drowsiness. In these cases the major part of the oil is generally vomited spontaneously, but the stomach-pump should in all cases be used, or failing that, an emetic should be given.

Poisoning by *opium, or by its alkaloids* is very common, and is getting more so, not from any increase of suicide by this means, but from the numerous instances of inadvertence occurring in the growing class of people who have acquired the habit of administering the drug to themselves.

When opium is taken for suicidal purposes, laudanum is generally employed, and it often happens that the suicide swallows a very large quantity. This very frequently leads to failure of the attempt, through the active vomiting which is set up.

The symptoms of opium poisoning are generally distinct enough. The slow shallow respiration, and feeble fluttering pulse, the pallid, almost livid skin, covered with a cold sweat, the obstinate drowsiness or profound stupor, and above all, the fixed contracted pupils, are sufficient evidence of the condition, even without any external or circumstantial proofs.

In this condition the respiratory centre is the part in greatest danger of striking work, and it must be kept going until the poison has been eliminated. By every possible means the patient must be roused, and kept awake. Generally the best way is to keep him walking about, supported, if necessary, on either

side,* while by shouting, slapping the face or chest with a wet towel, etc., every effort must be made to prevent a relapse into torpor. The nitrite of amyl may be inhaled with advantage, and it is very important that the patient be kept warm.

If there be any reason to suspect that there may be some of the poison still remaining in the stomach, the pump should be used, or an emetic given, and after that, strong, hot coffee should be freely drunk. It is often difficult to excite emesis on account of the action of the poison upon the vomiting centre in the medulla as well as upon the stomach walls. Apomorphine acts directly upon this centre, as sulphate of zinc, or mustard and water does upon the stomach; if, therefore, a brisk irritant emetic, (say 30 grains of sulphate of zinc) does not excite vomiting, it will be wise to give subcutaneously 1-10th grain of apomorphine. Any form of emetic is of course useless unless the poison has been taken by the mouth.

If, in spite of these efforts, the stupor deepens, and the respiration further fails, the stimulus of faradisation of the diaphragm may be tried; the surgeon must be ready to adopt artificial respiration, and may consider the advisability of administering the only drug which is believed to have an antagonistic action to that of opium, namely *atropine*. Opinions as to the truth of this antagonism are very contradictory; some *e.g.*, Dr. Fothergill, holding the fact to be indisputable, while others state that its administration actually intensifies the poisoning. On the whole there seems to be sufficient evidence for the antagonism, to justify the administration of the drug in extreme cases. The most convenient form will be by the hypodermic injection of liq. atropiæ sulphatis, 4 or 6 ♏ (1-20th to 1-50th gr. of the alkaloid) of which might be given for a dose, to be repeated, or slightly increased, if the symptoms seem to be improving under it.

* The Inspector at the nearest police station will usually detail relays of men for this purpose if he be asked; this will save the hospital porters much labour

When improvement has once commenced, it is generally continuous. The pupils may remain contracted for a long time, but when the respiration and circulation appear to be well established, and the patient is able to keep himself awake, the best treatment will be warmth in bed, when natural sleep will probably soon come on and may be encouraged. The patient should be watched, however, lest the respiration should again begin to fail and other symptoms of poisoning re-develop. Alcoholic stimulants seem to be hurtful in all stages of the poisoning.

Strychnia poisoning. This alkaloid is a common ingredient of "vermin powders," "beetle paste," and the like, so that strychnia poisoning by misadventure is rather frequent. The symptoms of this condition can only be mistaken for those of acute tetanus, and this error can hardly be made if attention be carefully given to the case for a short time. The condition is of course, a "tetanus" in both cases; but in that of the poisoning, the rapid development and acuteness of the attack, the universality of the convulsions, as opposed to the almost invariable spreading from the neck and jaw muscles in the ordinary tetanus, the nearly complete relaxation in the intermittent periods, and the fact that the duration of the whole attack is to be measured by hours—all these will enable a diagnosis to be made with almost absolute certainty, although indeed this is of the less importance in that the treatment may be much the same in either case.

In strychnia poisoning there is a very short period of abnormal restlessness, quickly followed by a general trembling, and then complete opisthotonos, with marked "risus sardonicus," and cyanosis. In half a minute, or a minute, the spasm relaxes and there is a period of exhaustion and respite, to be succeeded on the slightest irritation, or apparently without any cause, by a similar storm of reflex contraction. If death occurs, it will generally be from asphyxia or exhaustion, and will very often take place in less than an hour. If the dose has not been a fatal one,

the spasms will gradually diminish in frequency and force. Whether this alkaloid has been taken in the form of a vermin poison, or in any other way, it is impossible to attempt its removal by the stomach pump after the symptoms have once developed. In the treatment, the main reliance must be placed upon inhalations of chloroform, and large and frequently repeated doses of chloral hydrate and bromide of potassium. Nitrite of amyl, may be inhaled, ("and artificial respiration, if possible, performed, Murrell"). If by any means the first few hours can be tided over, hopes of recovery may be fairly entertained. If the form in which the poison has been taken be rather a bulky one, as a vermin poison, then in the first instance a brisk emetic, *e.g.*, one of sulphate of zinc, or of mustard and water, must be very promptly given; or $\frac{1}{5}$th of a grain of apomorphia may be injected subcutaneously.

Belladonna poisoning. This is generally accidental, as from eating the berries of the "Deadly Nightshade" (Atropa belladonna), swallowing lotions containing atropia, or through some similar mistake. The symptoms are very characteristic. The pupils are widely dilated, and the skin capillaries injected, producing a rash like that of scarlatina. There is much cerebral excitement, the delirium is generally chattering and restless, but may be extremely violent. The mouth is always parched, and the skin very dry.

Emesis must be performed by the stomach pump, or by sulphate of zinc, etc., or by apomorphine $\frac{1}{10}$ gr. and following this, stimulants should be given in the shape of alcohol or ether, as well as strong tea or coffee, which are also useful from the tannin they contain. Artificial respiration may be necessary in very severe cases, and in others external stimuli, such as douche, faradisation, etc.

Both morphia and chloral have an antagonistic action to atropia, but this is in neither case so distinct as that of *pilocarpine*, $\frac{1}{4}$ to $\frac{1}{2}$ gr. of which should be injected subcutaneously, and repeated if

sweating be not produced. 5 to 10 ♏ of a 1 in 20 solution of the alkaloid, or its hydro-chlorate, or ʒ ii of the tincture of Jaborandi will be the doses required.

Retention of urine is common in these cases, calling for the use of the catheter.

Prussic acid poisoning. The action of hydrocyanic acid is so intense that death is often almost instantaneous, or there may be just time enough for a cry of agony. Even in less acute cases the symptoms come on within a few minutes. There is first respiratory difficulty, and then a period of violent convulsive movements, which are general throughout the body, but especially affect the expiratory muscles. Vomiting, and involuntary urination and defæcation, occur. This stage is followed by a period of calm, with rapidly deepening paralysis and cyanosis. This usually is quickly followed by death. In fact the whole attack resembles an acute asphyxia, or rather is one, and although treatment is rarely successful, it must be directed towards maintaining the action of the respiratory centre in every possible way.

Should there be time for any attempts at restoration, an emetic should be given, or the stomach pump used, if it can be employed *at once*; then ammonia, as strong as can be borne by the patient, should be inhaled, and other stimulants freely given by the mouth if they can be swallowed, if not, then brandy and ether should be given hypodermically. Stimulant enemata may also be made use of. Alternate douches of cold and hot water, are powerful stimuli to respiration, and strong faradisation should always be applied if possible. Artificial respiration will most probably be called for as soon as the convulsive stage is over, and must be persevered in, although the condition may seem to be almost hopeless.

The materials used for prussic acid poisoning are usually either impure bitter almond oil, or the pharmacopœial, or "Scheele's" acid, or some one of the soluble cyanides so largely used by photographers.

The only substance which at all resembles it in its

action is *nitro-benzol*, or artificial oil of bitter almonds, nor would the treatment of poisoning by the latter differ in any respect.

Chloral poisoning. As in the case of opium poisoning, this is generally a poisoning by misadventure, due to the increasing habit of self-administration of drugs by the laity. The symptoms resemble in great measure those of opium poisoning, but the fixed contraction of the pupils is absent, and the circulation is affected quite as much as is the respiration.

In all respects of rousing, emetics, etc., the treatment is the same as for opium, and so also with regard to affusion, faradisation and artificial respiration. It is even more important than in opium poisoning that warmth should be kept up, and the administration of a pint of hot strong coffee by the rectum will fulfil the indications of warmth and stimulation.

With regard to an antagonist, the most distinct one is strychnia; 4 ♏ of the liq. strychniæ may be injected beneath the skin, and repeated every 10 or 20 minutes if necessary.

The irritant and corrosive poisons may conveniently be grouped together, for the symptoms of the latter only differ from the former in their greater intensity. Moreover many of the substances in our list, in weaker solutions are irritant poisons, and corrosive poisons when concentrated. In most cases the local effects are so marked that any constitutional results of their absorption are unnoticed.

The following is the general sequence of events after an irritant poison has been swallowed. There is first a burning metallic taste in the mouth and throat, and then a sense of intolerable pain referred to the chest, behind the sternum (heartburn). This is followed by increasing general abdominal pain, so that the legs are drawn up, as in peritonitis, and the belly becomes tumid. Vomiting is almost invariably present, and there is generally great thirst.

If the poison has been taken in a quantity in-

sufficient to cause speedy death, and if it be *irritant* only, and not corrosive, the above are the chief symptoms. In the less severe cases these may, with appropriate treatment, be subdued ; on the other hand if the dose be a fatal one, the symptoms of irritation will quickly be followed by dyspnœa and increasing collapse, so that the patient looks to be in the algid stage of cholera, and this will continue until death by syncope occurs.

But if the substance be truly *corrosive* in its action, such as one of the concentrated mineral acids, the symptoms are even more severe, and run a much more acute course ; it is probable that no recovery has ever taken place after such a poison has been swallowed, so that any quantity has passed into the stomach, although instances are common of great damage to the throat and œsophagus being followed by recovery ; or, we should rather say, by recovery in the first instance, for generally the consequent cicatrisation has led to contraction and stricture.

The damage to the lips and throat is the first and most prominent symptom, and gives the measure of the extent of the corrosion of the parts lower down. The corners of the mouth will be marked, and the tongue and palate covered, with a whitish coat of slough, "like a coat of paint," if sulphuric, or hydrochloric acid, or corrosive sublimate has been used ; or with a yellow stain, in the case of nitric acid.

In the presence of these signs of corrosion a very few minutes will decide whether the poison has been really swallowed. If so, the symptoms which have just been detailed will develop, but more rapidly and more acutely. The stage of collapse is reached more quickly, and there are signs of actual destruction of the viscera. The vomit contains shreds of sloughing mucous membrane, or it may be, casts of whole sections of the œsophagus. The abdomen becomes enormously distended with gas. The dyspnœa and dysphagia are both intense, and death usually occurs within a few hours.

In many respects the treatment of poisoning by irritant or corrosive substances is common to them all; and again, with regard to many, there are some particular antidotal drugs, or some especial measures to be taken or avoided.

In the first place, the stomach-pump should be used, unless there be evidence of such corrosion as to make it probable that the walls of the œsophagus or stomach are too much damaged for the tube to be safely passed. Such a case is indeed practically hopeless from the first, unless the damage be confined to the upper part of the canal.

The vomiting, which is almost always present, should be encouraged by giving warm water, or mustard and water, or by the injection of apomorphia.

As soon as the stomach has been relieved of the poison, raw egg, albumen, milk, barley water, arrowroot, or whatever mucilaginous fluid can be most readily procured, should be given. Egg albumen, raw, is probably the best of all in all cases, as well as having a special action on corrosive sublimate. Salad oil may generally be given with good results, except in the case of phosphorus poisoning. The rest of the general treatment of irritant poisoning will be directed towards the symptoms of peritonitis and collapse. The pain must be subdued with full doses of opiates. The warmth of the body must be maintained, and the other signs of shock combatted by such stimulation as the inhalation of ammonia, or nitrite of amyl, the subcutaneous injection of ether and brandy, stimulant enemata, faradisation of the extremities, etc. Morphia by hypodermic injection will also generally be indicated.

Special points in the treatment of particular irritant and corrosive poisons

I. *For irritant and corrosive acids.*

These comprise sulphuric, nitric, hydrochloric, oxalic, and carbolic acids; the symptoms in the case of the first three will be similar, and in accordance with those results of swallowing any corrosive fluid which have

just been described. The acuteness of the symptoms will vary directly with the strength of the solution, and inversely with the quantity of food in the stomach. In all, if a strong solution be actually swallowed, the symptoms will be of the most urgent kind, and will be rapidly fatal if not at once counteracted, so that time is of the utmost importance. The stomach pump may not safely be used unless the acid has been in quite a dilute solution. The charring in the case of nitric acid is yellow, and the vomit possesses a nitrous smell. In sulphuric and hydrochloric acids, the lips and mouth are whitish, and the vomit dark or black, containing charred shreds of mucous membrane.

The treatment lies in diluting and neutralising the acid as quickly as possible, so that all remedies should themselves be copiously diluted. Lime water (the saccharated is the best) whiting and water, chalk and water, soap and water, ordinary washing soda, or the bi-carbonates of soda or potash, or any of the preparations of magnesia, in solution, are all useful alkaline remedies. Some of them will almost certainly be at hand in any given case, and it should always be borne in mind that "the nearest remedy is the best."

In addition to alkalies, milk, olive oil, and the other demulcents mentioned above are all useful.

In poisoning by *Oxalic acid* or by *Salts of sorrel* (the acid oxalate of potash) the main special point to bear in mind is that the alkaline oxalates are soluble and poisonous, so that chalk, whiting, lime water, or magnesia must be used to neutralise the acid, and not soda, potash, or ammonia, or the carbonates of any of these. Oxalic acid poisoning is rather common and is frequently suicidal. The symptoms are those already detailed, save that collapse is often disproportionately marked, and that death may be very speedy.

Carbolic acid poisoning is now perhaps the commonest of all forms of poisoning by misadventure and is also used for the purposes of suicide. Its corrosive action is, in concentrated solutions, very conspicuous, but the destruction does not extend deeply into the

tissues. The mouth and jaws are usually covered with a white, leathery pellicle. The symptoms are those of poisoning by any corrosive fluid, but pain is even more intense than in the case of the other acids, while on the other hand the collapse, and other symptoms of the gravest local injury are not so manifest, nor is the whole course of events after the poison has been taken, so hurried.

Treatment. The sulphates of magnesia, or soda, in half ounce doses in a tumblerful of warm water should be given at once and the stomach washed out with warm water, or with the same alkaline solution three or four times, half a pint or so of the solution being afterwards left in the stomach. In the absence of the stomach pump, vomiting must be produced by zinc sulphate, mustard and water, ipecacuanha, or the injection of apomorphia. Later on demulcents, such as barley water, olive oil, etc., may be given, or an ounce of castor oil.

Shock is often very marked and must be treated by frictional warmth, ammonia, etc. as before stated. If there be much restlessness *chloral* should be given, as there is an antagonism between it and carbolic acid.

The urine is often dark and scanty and may be suppressed, in acute carbolic acid poisoning. The carboluria is then a grave symptom, but it often happens in surgical cases, that carbolic acid, not necessarily used in very large quantities, is absorbed and produces a similar inky urine.

II. For *corrosive sublimate* (perchloride of mercury) the acid nitrate of mercury, etc. albumen in any shape (even gluten of flour is better than none, but white of egg is best) should be freely given, as an insoluble albuminate is thus formed. Emesis should be encouraged by warm water or mustard and water, if vomiting be not active without such aid. If the solution has been concentrated, the stomach pump must only be used with great care.

III. *Arsenical poisoning* is generally effected by arsenious acid (white arsenic), and is frequently given

with criminal intent. The symptoms do not come on immediately after taking the poison. The vomiting and purging resemble at first an intensely violent bilious attack; afterwards the symptoms are more like acute cholera, and the diagnosis is often obscure. The emesis must be encouraged, and the stomach emptied by the pump. This should be followed up with oil, switched eggs, or a mixture of oil and saccharated lime water. Magnesia is also very useful, but the substance which best neutralises the action of arsenic or arsenious acid in solution, is the freshly prepared hydrated peroxide of iron. This can be quickly made by adding half-an-ounce of common carbonate of soda to a fluid ounce of tinct. or liq. Ferri perchlor., and filtering. As a substitute, dialysed iron in ounce doses may be given.

If the diagnosis of the acute form of this poisoning is not generally easy, that of chronic arsenical poisoning is always difficult, but this condition does not fall under the heading of emergencies.

IV. *Poisoning with antimony*, in the form of tartar emetic.

The symptoms come on soon, and generally the vomiting is so violent that the whole of the poison is soon ejected. If not, the symptoms resemble those of arsenical poisoning, but there is more depression. The treatment is the same as in arsenical poisoning; but in addition, *tannin* should be given in the form of very strong tea or coffee, or by means of preparations of oak or cinchona bark, or of tannic acid itself.

V. *Poisoning with phosphorus.* This is usually taken in the form of beetle paste, or rat paste, or sometimes by swallowing the heads of lucifer matches. In these cases the symptoms declare themselves soon after the poison has been taken, and are generally prolonged over days, or it may be weeks. The prominent symptoms are great thirst, with heartburn, and violent vomiting, the vomit being phosphorescent in the dark, and the breath smelling strongly of the poison.

The result will mainly depend on whether the vomiting be sufficiently active to prevent an absorp-

tion of a really poisonous amount. If the quantity absorbed be large, the symptoms remain acute; hæmatemesis and bloody purging are often present, with cramps, and finally coma. But if only a small, but still poisonous quantity has been taken (say ½ to 1 gr.), after the first indications of irritation have passed over the symptoms usually subside for a day or two, and then the signs of acute atrophy of the liver begin to declare themselves. Then the jaundice deepens, and a comatose, typhoid condition, with delirium, generally ends in death in a few days, although in some of the milder cases recovery may take place. The early treatment of the poisoning does not differ from that of other irritants, save that oil, in which phosphorus is soluble, should never be employed with the idea of soothing the intestinal mucous membrane. After the stomach has been emptied of its contents either naturally or with the stomach pump, mucilage, magnesia in barley water, or similar demulcent fluids may be given. The only drug which seems to have any action in preventing the liver changes is the French oil of turpentine in full repeated doses of 15 ♏ to ʒss.

Chronic phosphorus poisoning, phosphorus necrosis, etc., cannot here be discussed, as they do not occur as emergencies.

VI. *Poisoning by caustic alkalies and their carbonates.* This form of poisoning is rare, but potash or soda lye is sometimes taken. The symptoms are those of ordinary irritant poisoning, except that violent purging is generally a prominent symptom. In the treatment the question of the use of the stomach-pump must be decided by the amount of caustic destruction. Weak acids, such as vinegar and water, or any of the dilute pharmacopœial acids, should always be given.

Poisonous Foods. A form of acute gastro-intestinal irritation, often so severe as to justify the term poisoning, is not infrequent as a result of eating shell fish, especially mussels.

In the treatment, an emetic should be given in the first place, and afterwards a full dose of castor oil with

20 to 30 ♏ of laudanum, chlorodyne, or of some similar sedative. This is to be repeated if necessary. Atropia is here also indicated, although not so distinctly as in the case of poisoning by muscarin. The manner of administering, and the dose, are the same as in the following case.

Mushroom poisoning should not go without mention, although in London cases are rare. Most fungi, edible or inedible, may produce, if improperly cooked, symptoms of a mild degree of irritant poisoning, similar to those which have been mentioned, and which may be treated in a similar way. But cases of true *muscarin* poisoning exhibit a much higher grade of toxic symptoms. The fungi which contain muscarin or some similar alkaloid are not very numerous in England, the principal one being the fly fungus (Amanita muscaria). When the more actively poisonous fungi have been eaten, as a rule great cerebral excitement is caused, in addition to the more strictly irritative effects on the alimentary tract.

In the antagonism between *muscarin* and *atropia* we have perhaps the best example of this mode of the physiological action of drugs. Digitalis also, though in a less degree, is antagonistic to muscarin. Whenever, therefore, the symptoms of mushroom poisoning are grave, and especially if there be delirium or mania, atropia should be given, say iii to v ♏ of the liq. atropiæ, by the mouth, or ii. ♏ subcutaneously, or as an alternative treatment, full doses of the tincture or infusion of digitalis may be administered. In other respects the treatment should consist in removing the poison from the alimentary tract as soon as possible, by means of emetics, etc., and in allaying the irritation by demulcents.*

* In this chapter the directions as regards the administration of *antagonists* have been retained for the sake of completeness, but no unqualified person would be justified in administering an antagonistic dose of a powerful drug on his own responsibility. For further information as to the treatment of cases of poisoning the reader is referred to Dr. Murrell's excellent little pocket book ("What to do in cases of Poisoning," H. K. Lewis, 1884).

Of the washing out of the stomach, and of the use of the stomach pump.

The use of the stomach pump in cases of poisoning has been already several times alluded to, but it is employed on many other occasions as well, as for the feeding of refractory patients, or in the treatment of some forms of dyspepsia.

There are several forms of the pump, but a very common and convenient one is that here figured (Fig. 78). It is made on what is known as the "flute key"

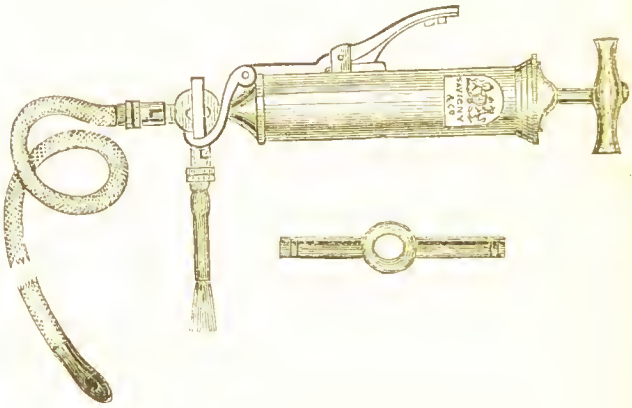


FIG. 78.—*Flute-keyed Stomach Pump.*

principle, and its action can be readily understood from the illustration. The tap of the pump is a two-wayed one, and if the piston were to be drawn out while the lever at the top in the figure remained in the position in which it is drawn, fluid would be sucked into the cylinder from the vertical tube, and similarly expelled by that tube, if the piston were afterwards pushed in. But if the lever be depressed, the vertical tube will be shut off, and the horizontal one will now be in communication with the cylinder and piston ; so that, by depressing and raising the lever synchronously

with the to and fro movement of the piston, fluids may be sucked from the vertical tube, and expelled by the horizontal one, or *vice versa*, according to the relative position of the lever and piston.

The important point in the use of the stomach pump is the insertion of the tube. In restless or refractory patients it will be necessary to use a gag, and although almost any form will do, the best is a piece of hard wood, of such a size that it will lie across the mouth between the front molar teeth, and it should be broad enough to allow of a hole being bored through its centre, through which the tube can be passed. (*Vide* Fig. 78.)

In other cases no gag is required, and then the tube, which is made of gum elastic, having been well warmed and softened, can be passed with the right hand and guided by the left forefinger through the pharynx and down the gullet, with much greater ease. As soon as the end of the tube enters the œsophagus the choking usually stops. Supposing the case to be one in which the removal of something hurtful from the stomach is the object of the operation, after the tube has been passed, not less than half a pint of warm water, or of some special fluid, must be injected into the stomach before anything is sucked from it. The stomach may then safely be emptied, and the process of injection and suction repeated until the object is attained.

In cases of poisoning, a pint of water, or of some bland, soothing fluid should be left in the stomach; as also in the case of simple drunkenness, unless it be desired to leave an emetic injection instead. If, however, the pump has been employed for the purpose of washing the mucous membrane, and removing the fermenting secretions of water-brash, or similar forms of dyspepsia, only that amount of fluid should be left behind which the pump will not readily remove.

But the mechanism of a syringe with its taps and valves may be readily dispensed with, and the stomach may be washed out on the syphon principle very easily indeed. All that is required is the tube of the stomach

pump, an india-rubber tube capable of being attached to this, and a funnel. The stomach tube having been passed, the tube and funnel are joined on, and then, by alternately pouring in fluid (the funnel being held about 2ft. 6in. above the level of the stomach) and then removing it by lowering the tube to an equal distance below, the operation of washing out the stomach can be reduced to its simplest conditions.*

Of the Hypodermic syringe.

There are a number of patterns of hypodermic syringes, but their varieties involve no real difference of principle. They all are graduated to deliver the fluid to the injected, by measured drops, and it matters little if this be effected by a screw, or a thrust, piston. Fig. 79 is an illustration of a good form of the instrument.

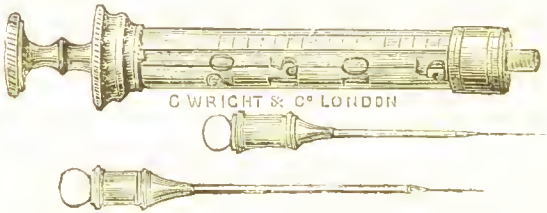


FIG. 79.—*Syringe for Hypodermic Injection.*

In Fig. 80 we have shown the manner of inserting the hypodermic needle. The special points to be observed are, (1) that the needle should be thrust into the subcutaneous tissue at some place where it is loose and where the skin is free from veins.

(2.) The fluid having been injected, the needle should be withdrawn quickly, and then, the puncture being covered by the point of the finger, the injected fluid

* But a stomach pump tube, or a tube with a certain amount of stiffness is essential. Few persons at any time, and no one who was suffering from acute poisoning, could possibly *swallow* some feet of india-rubber tubing as has been suggested.

should be dispersed into the tissues by gentle rubbing.

(3.) Lastly, and this point we would most strongly



FIG. 80.—*Method of Hypodermic Injection.*

insist upon, no surgeon, house-surgeon, or dresser, should ever be induced to instruct a patient, or any one of the laity, in the art of self-injection. A syringe and a bottle of morphia are tools far too unsafe, and far too seductive, to leave in hands where they may be tampered with, and used, it may be unwittingly, as agents for self-destruction.

Chapter XII.

of surgical case taking.

The art of taking notes of surgical cases well, is one not easily acquired, and for the notes to be of much value, something more than vague general notions upon surgical subjects must be pre-supposed. Yet in many hospitals, dressers who are beginning their work in the surgical wards, or clinical clerks in the medical ones, are expected to be able to write intelligible histories of cases which are to them very possibly obscure to the last degree; and further, to write these so that their account shall stand for all time as being full, true, and particular, so that those, who may on some future occasion require to look up the case books of the hospital, will find therein a trustworthy account of whatever case, or group of cases, may be under investigation.

Notes which will perfectly fulfil these conditions can hardly be expected, and will only exceptionally be obtained from dressers, at any rate during the first few months of their ward work; but nevertheless there is hardly any other part of these same dressers' work which will be so useful to him educationally, as his case taking. *Litera scripta manet*, and he will find that every case which he intelligently records, (and therefore studies, because he *has* to record) will remain with him a lifelong experience.

What he must aim at in his case taking must be first and foremost, *absolute truth*, and it will be found that sometimes there is a strong temptation to make the facts square with a preconceived theory; and secondly, to present a clear story, of the case, without introducing any personal opinions, letting the facts tell their own tale.

The notes of a case then, should comprise.

(1) A description of the patient, and of the symptoms, objective and subjective, presented by him (or her, but for shortness we will use the male appellation) when he first comes under the notice of whomsoever has to record the case.

(2) An account of those facts in his previous life history, and in his family history, which may throw light upon his present condition, and the sources of this information.

(3) The previous story of the illness, derived from the patient himself, his parents, or from other people, the source being in all cases stated.

(4) A *diary* recording the measures, operative and other, which are adopted for the relief of his complaint, after he has come under observation, and the subsequent course of events.

(5) The *result* of such treatment, namely, cured, relieved, unrelieved, or died, and in the last event.

(6) Whether or no a *post mortem* examination was made, and if so, an account of the results of this examination.

The following scheme will be found a generally convenient and workable plan for recording cases upon the lines we have here laid down.

Ward / Name.	Sex.	Age.	No. of Register. / Occupation.	Date of admission. / Residence.	Date of discharge.	Result – Cured / Relieved / Unrelieved / Died.

By whom taken.	Name of Surgeon.	Date of taking case.

History of the present illness from its commencement up to the date of taking the case, as derived from the patient, or from his friends or relatives (state the source), given in as possible the words actually used by them.

The patient's previous history,
including (*a*) previous illness.
(*b*) habits of life (state source of information).
(*c*) other facts bearing on this part of the case.

The patient's family history,
i.e., (*a*) if the parents are alive or dead, if the latter, at what ages and how.
(*b*) Brothers and sisters, No. of, whether alive or dead, etc.
(*c*) Place of patient in his family.
(*d*) Results of enquiries about hereditary tendencies, as to gout, insanity, cancer, etc.

The patient's condition at the time of taking the case,
(*a*) General description. Position of patient in bed. State of nutrition, local and general. Indications of a diathesis (*i.e.*, strumous, syphilitic, etc.). The condition of the organs of circulation, respiration and digestion. The condition of the skin and of the glands. The temperature (noting time when taken). The appearance, sp. gr., and quantity of urine passed, and whether albumen is present or no. The condition of the organs of motion and locomotion. Sleep, its amount and character of.
(*b*) Description of actual seat of disease, its locality, its *objective* physical appearances, and the *subjective* abnormal sensations connected with it.
(*c*) Other noteworthy local abnormalities.

The "case" being thus taken, it will be the duty of the dresser, or of whomsoever is appointed to continue the record, to preserve a consecutive account of the the course of events from the moment the patient comes under treatment.

If an operation be performed, it must be fully described, especial attention being paid to the following points.

The actual incisions and manipulation. The approximate amount of blood lost, and the condition of the patient at the close of operation. The number and method of insertion of sutures (if any used). The position of the drainage tubes. The plan of dressing the wound, the position of the patient subsequently in bed, and the nature of the anæsthetic.

If the operation be of the nature of *a removal*, either of a growth or of a limb, the notes must always describe fully the part taken away. For example, if the thigh be amputated in its lower third, for disease of the knee, the details of the condition of the joint,

and its ligaments, the muscles, etc., in its neighbourhood, the cartilages and the bones, must all be fully pictured. Were the case one of an epithelioma of the lip, in addition to the naked eye appearances of the growth, its microscopic structure should also be given.

As the case goes on it will probably be found unnecessary to make daily entries on the case paper, but however chronic the disease in question may be, and however slow the convalescence, it will be found convenient to make some note of the patient's condition at the very least once, and as a rule, twice in the week, upon the occasion of the surgeon going his rounds.

The patient's temperature is now commonly taken night and morning by a ward nurse, and entered upon a chart, appended to the case book. This plan is a good one in many ways, inasmuch as the observations are made at every 12 hours, and at the most suitable times, but it involves a certain risk that this condition of the patient may be overlooked by the dresser. It should therefore be a rule that the temperature readings should be entered in the notes, as well as placed upon the chart, in all serious cases.

When the notes record a patient's discharge the extent of recovery should always be noted, and in the case of death, the actual cause should be carefully stated, if it be apparent; in those cases where a *post mortem* examination is made, the results must be fully recorded, and the dresser should be especially careful not to lose this opportunity of clearing up obscurities, and verifying and correcting opinions formed during the patient's lifetime.

THE END

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